SIEMENS

KION / KION-i anesthesia workstation

Service Manual

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Notes

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Important

1

General

- Service documentation for the KION™ / KION-i™ anesthesia workstation consists of:
  - Operating Manual. The Operating Manual is an indispensable complement to the Service Manual for proper servicing.
  - Service Manual
  - Installation Instructions
  - Spare Parts information
  - Documentation for the KION / KION-i Monitor.
  - Documentation for all optional equipment included in the KION / KION-i workstation.
- The following conventions are used throughout this Service Manual:
  - **KION** represents KION anesthesia workstation.
  - **KION-i** represents KION-i anesthesia workstation.
- The information in this Service Manual is based on:
  - KION version 7.x.
  - KION-i version 10.x.

  The information in this Service Manual is valid for both versions unless otherwise stated.
- Serial number of the unit is found on a label attached by the mains power inlet.
- A system version label is found by the mains power inlet. Make sure that the version of the Operating Manual corresponds to this system version.

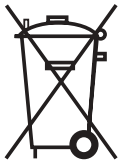
Text inside a box is used to highlight important information.

- In addition to the Important information given here and in the related documents (e. g. in the Operating Manual), always pay attention to applicable local and national regulations.
- Responsibility for the safe functioning of the equipment reverts to the owner or user in all cases in which service or repair has been done by a non-professional or by persons who are not employed by or authorized by Siemens, and when the equipment is used for other than its intended purpose.

Symbols used in this manual

- **ESD sensitive components**. When handling ESD-sensitive devices, established procedures must be observed to prevent damage.

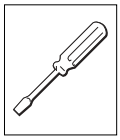
- **Special waste**. Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.



- **Recycling**. Recycle if possible. Recycling facilities may not be available in all areas.

- **Technical training**. Refers to the Technical training supplied by Siemens.

- **Service contract**. Refers to the Service contract supplied by Siemens.



Hazard notices

- Before disassembling or assembling, make sure that:
  - Gas supply is disconnected.
  - Mains power cable is disconnected.
  - Power switch is set to Off. If the power switch is set in any other position, the internal battery will supply power to the PC boards.
  - The internal battery is disconnected when the power section is open.
  - All gas conveying parts are cleaned according to instructions in the KION / KION-i – Operating Manual, chapter Routine cleaning.
- With power supply connected to the KION / KION-i workstation, there are energized electrical components inside the unit. All personnel must exercise extreme caution if fault tracing or adjustments are performed with power supply connected and with user interface and patient unit covers removed.

Installation

- Only personnel trained and authorized by Siemens shall be permitted to install the KION / KION-i workstation. The installation and handing-over procedures are described in the "Installation Instructions".

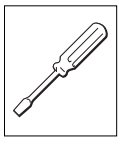
Important

Calibration and Functional check

- After any installation, maintenance or service intervention in KION / KION-i workstation, perform a "Calibration" and a "Function check" according to instructions in the KION / KION-i – Operating Manual.

Service

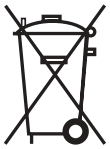
- The KION / KION-i workstation must be serviced at regular intervals by personnel trained and authorized by Siemens. Any maintenance or service must be noted in a log book provided.



- It is recommended that maintenance and service is done as a part of a service contract with Siemens.

- Preventive maintenance must be performed every:
  - Six months. This corresponds to approx. 1.000 hours of operation calculated as operating time of 40 hours a week during six months. Details are found in the Operating Manual.
  - Twelve months or every 3000 hours of operation whichever comes first. Details are found in this Service Manual, chapter "Preventive maintenance".
  - Three years. The internal battery shall be replaced every three years according to instructions in this Service Manual, chapter "Preventive maintenance".

- Worn-out batteries must be recycled or disposed of properly according to local regulations. Recycle facilities may not be available in all areas.



- Batteries must not be disposed of with ordinary waste. Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

- When handling ESD-sensitive devices, established procedures must be observed to prevent damage.

To the responsible service personnel

- The contents of this document are not binding. If any significant difference is found between the product and this document, please contact Siemens for further information.
- We reserve the right to modify products without amending this document or advising the user.

- Only personnel trained and authorized by Siemens shall be permitted to perform service or repair the KION / KION-i workstation. Only Siemens genuine spare parts must be used. PC boards (spare parts) must always be kept in a package for sensitive electronic devices. Siemens will not otherwise assume responsibility for the materials used, the work performed or any possible consequences of same.
- The device complies to standards and requirements as stated in the KION / KION-i workstation – Operating Manual.

Notes

Only personnel trained and authorized by Siemens shall be permitted to perform installation, service or maintenance of the KION / KION-i workstation.

Make sure to prepare the KION / KION-i workstation properly before disassembling and assembling. Refer to section "Hazard notices" in chapter "Important".

Any service or maintenance must be noted in a log book.

Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

After any installation, maintenance or service intervention in the KION / KION-i, perform a "Calibration" and a "Function check".
Refer to the "KION / KION-i anesthesia workstation – Operating Manual" for details.

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2

Main units

The KION / KION-i workstation can be divided into the following functional main units:

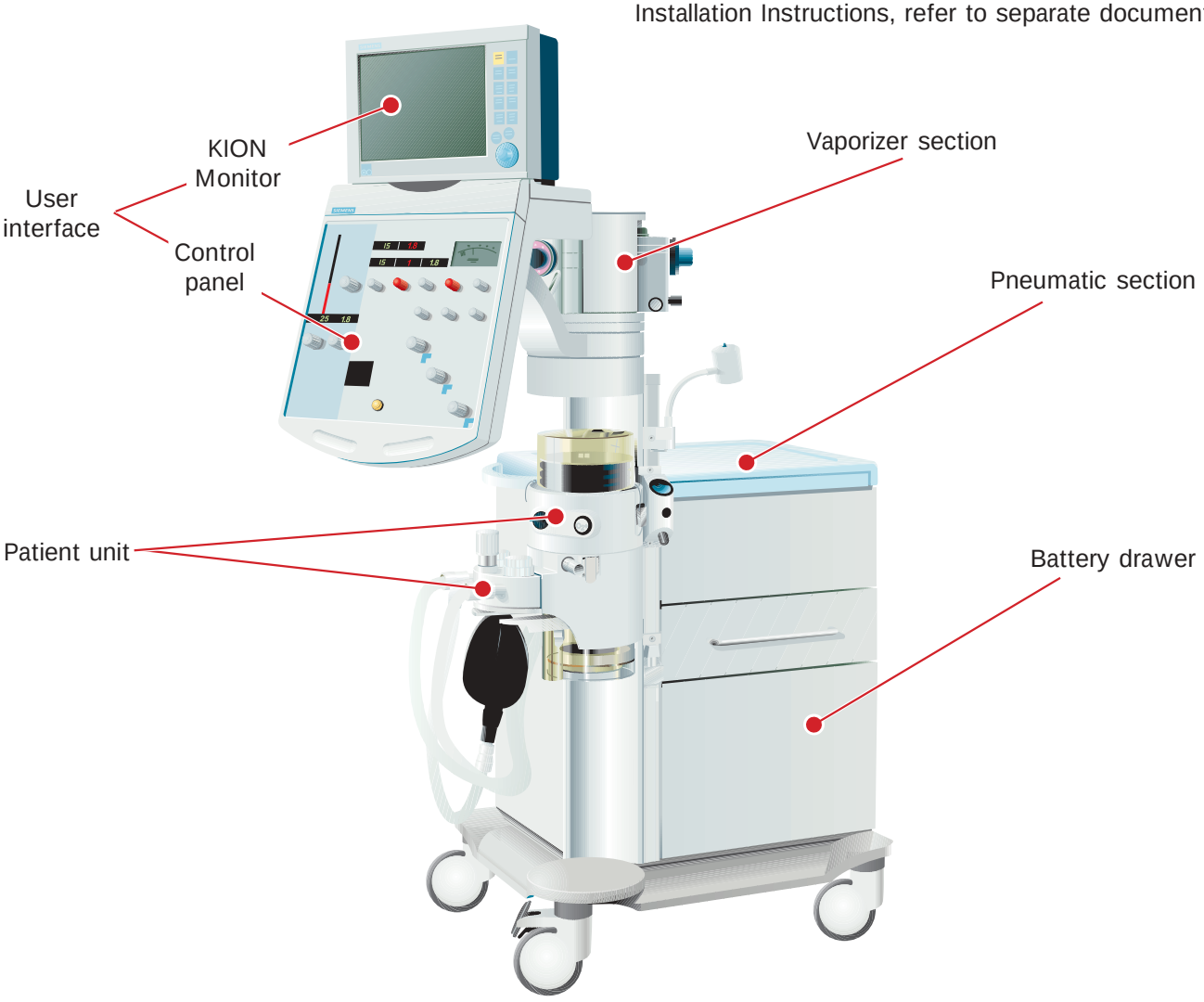
- User interface, i. e. the Control panel and the KION Monitor. The Monitor is a Siemens patient monitor (SC 7000, SC 9000 or SC 9000XL) used with the KION / KION-i workstation.
- Battery drawer
- Pneumatic section
- Vaporizer section
- Patient unit.

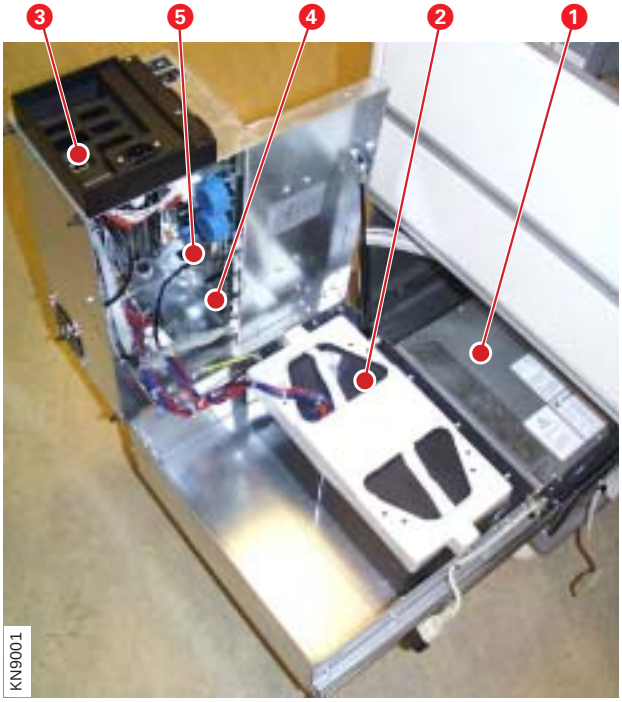
All these main units are incorporated in or attached to the cart which is the main body of the system.

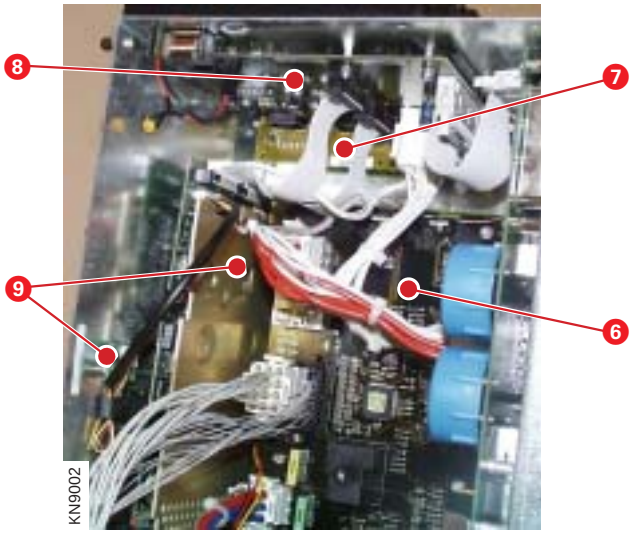
The following optional equipment can also be incorporated in the KION / KION-i workstation:

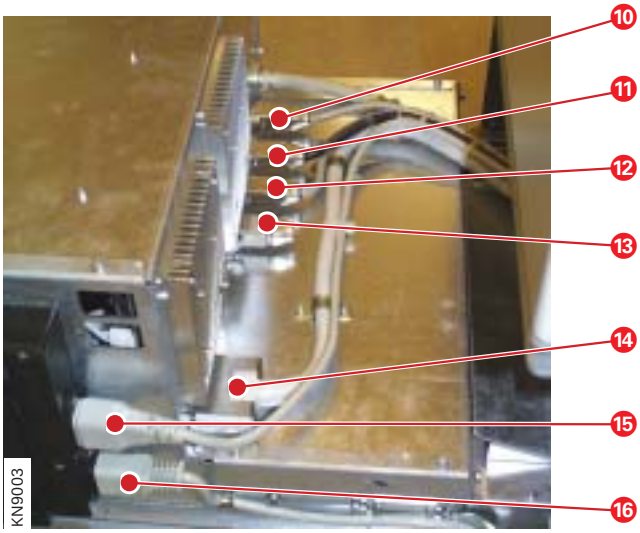
- DuoView™ overflow screen
- Built-in multigas analyzer
  - – KION MultiGas 2000
  - – KION MultiGas+
- O2 Monitoring MiniOX
- Isolation transformer
- Backup gas supply manifold
- Suction equipment
- Auxiliary O_2 supply
- Gas evacuation
- Accessory and Monitor shelfs
- Medside Data Station for KION.

Functional descriptions, as well as service and maintenance procedures for these optional equipments, can be found in this Service Manual. For Installation Instructions, refer to separate documents.









Battery drawer

The battery drawer can be pulled out from the cart for easy access. It contains functions for power supply and communication:

1. AC/DC Converter
2. Internal battery. An optional Extra internal battery can be installed to prolong the backup time.

Included in the Battery drawer is also the Power & Communication interface containing:

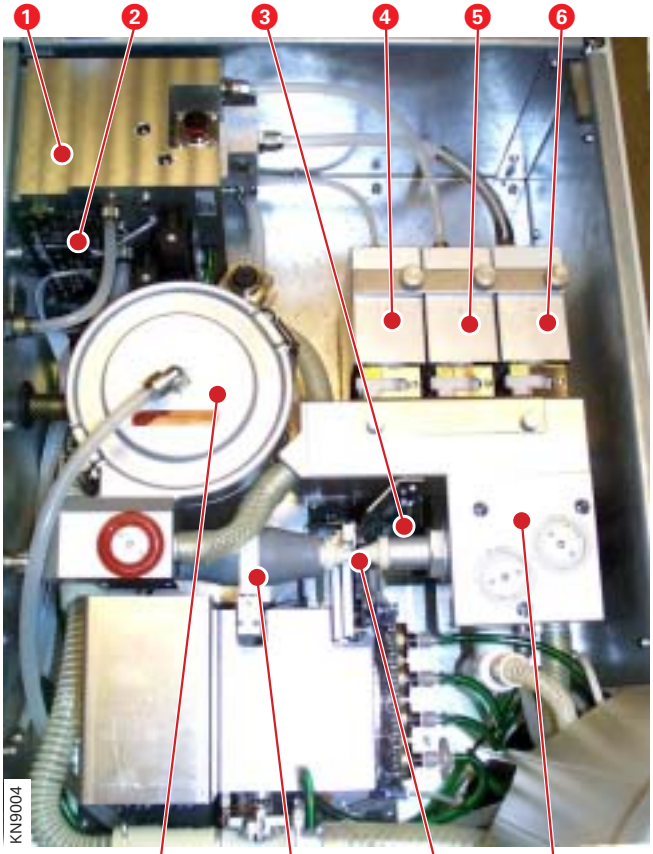
3. Communication ports
4. PC 1747 CAN/RS232 Interface
5. PC 1753 DC/DC Converter
6. PC 1675 Power Supply
7. MIB Connector (MIB = Medical Information Bus):
   - PC 1761 for KION with S/N 03645 or lower.
   - PC 1843 for KION / KION-i with S/N 03646 or higher.
8. Connector board:
   - PC 1754 for KION with S/N 03645 or lower.
   - PC 1856 for KION / KION-i with S/N 03646 or higher.
9. Communication Interface board:
   - PC A101 CPS Network PCB including the small PC A301 Monitor Option and Setup Memory Board for KION with S/N 03645 or lower.
   - PC A110 IDS Network PCB and PC A120 CAN/MIB for KION / KION-i with S/N 03646 or higher (not shown in illustration).

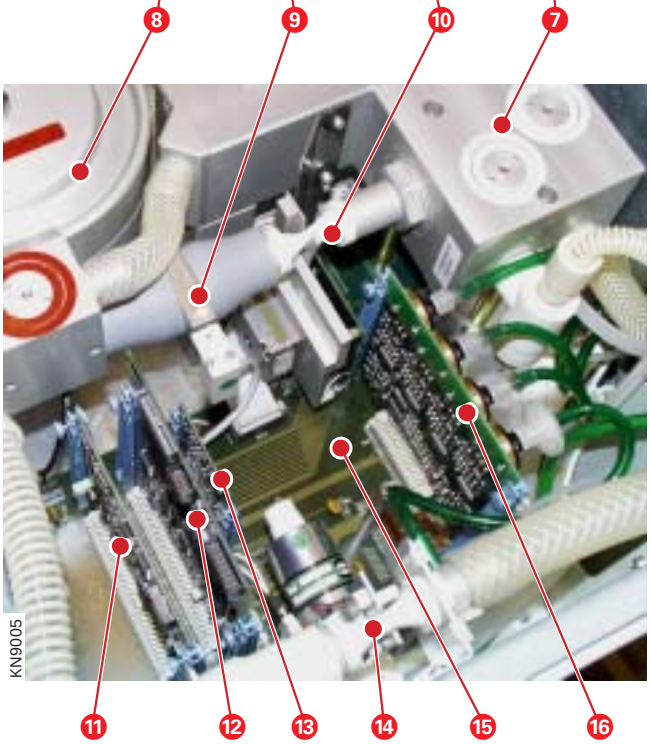
   These PC boards are also included in the Siemens patient monitor Communication/Power Supply module alt. Infinity Docking Station module. For further information regarding these modules, refer e. g. to the SC 7000/9000XL or SC 9000 Service Manuals.

The following cables are connected to the Power & Communication interface:

10. Multigas analyzer communication cable (RS232)
11. Multigas analyzer power cable (24 V DC)
12. DuoView cable (RS232 & supply voltage)
13. CAN loop-back
14. KION / KION-i Monitor communication cable (TAXI and supply voltage)
15. Isolation transformer cable (optional)
16. AC/DC Converter cable.

2





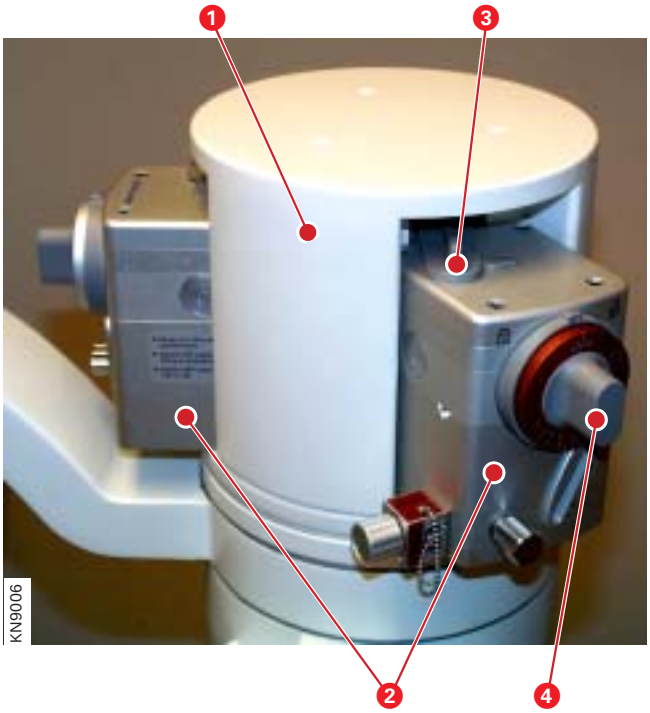
Pneumatic section

The pneumatic section, accessible when the top cover and shield cover is removed, controls the inspiratory fresh gas flow and the expiratory gas flow.

The main parts inside the pneumatic section are:

1. Gas distribution block
2. PC 1720 Wall Pressure
3. PC 1765 Valve Interconnection
4. Gas module AIR (N_2O) – BP
5. Gas module O_2 – BP
6. Gas module Drive Gas AIR (O_2)
7. Inspiratory gas block
8. Fresh gas pressure container
9. Inspiratory fresh gas flow transducer
10. Inspiratory fresh gas valve with PC 1751 Step Motor
11. PC 1737 Measuring
12. PC 1730 Control
13. PC 1797 Fresh Gas Flow (PC 1748 on units with S/N 00125 – 01405)
14. PEEP valve
15. PC 1796 Interconnection (PC 1733 on units with S/N 00125 – 01405)
16. PC 1750 Transducer including four pressure transducers:
    - On PC 1750A/B, the four pressure transducers are the integrated in PC 1750.
    - As from PC 1750C or later, four separate pressure transducers, PC 1781 Pressure Transducer board, are used (not shown in illustration).

The PC board protective plate shown in the upper illustration was introduced on KION workstations delivered as from July 1998.



Vaporizer section

The vaporizers used in the KION / KION-i workstation are the Precision Injection Vaporizers, PIVap.

The vaporizers are color-coded for the different anesthetic liquids and the filling is key-indexed.

Three vaporizers can be mounted onto the vaporizer magazine. The main functions are:

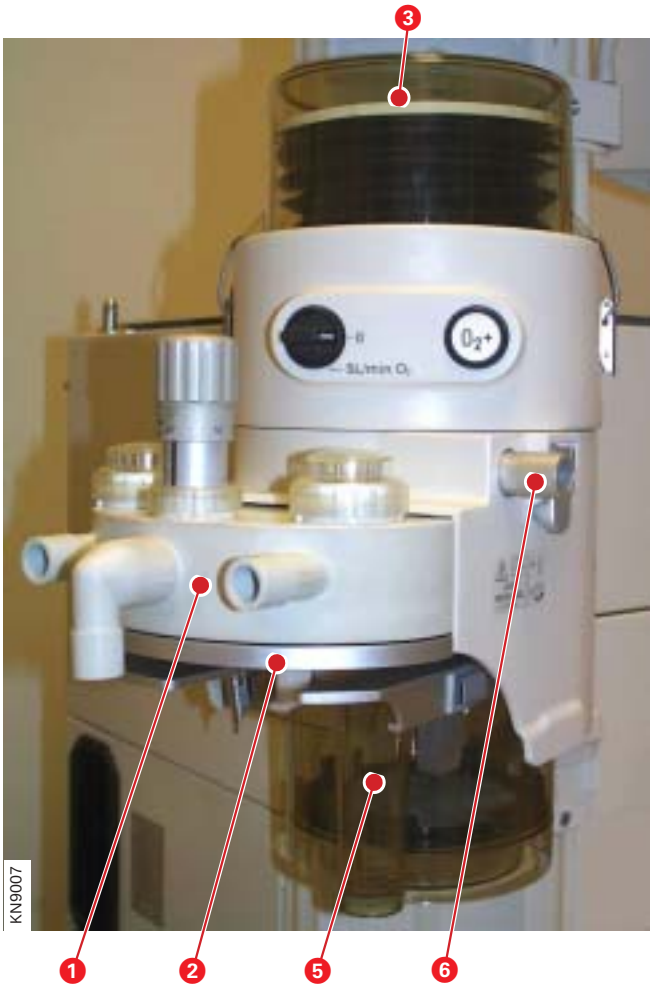
1. Vaporizer magazine. The magazine can be revolved to facilitate easy access to the active vaporizer.
2. PIVap vaporizers
3. Vaporizer locking lever
4. Vaporizer concentration knob. Only one vaporizer can be active at a time due to the interlocking system. To activate the vaporizer; push-in and turn the vaporizer concentration knob counter-clockwise.

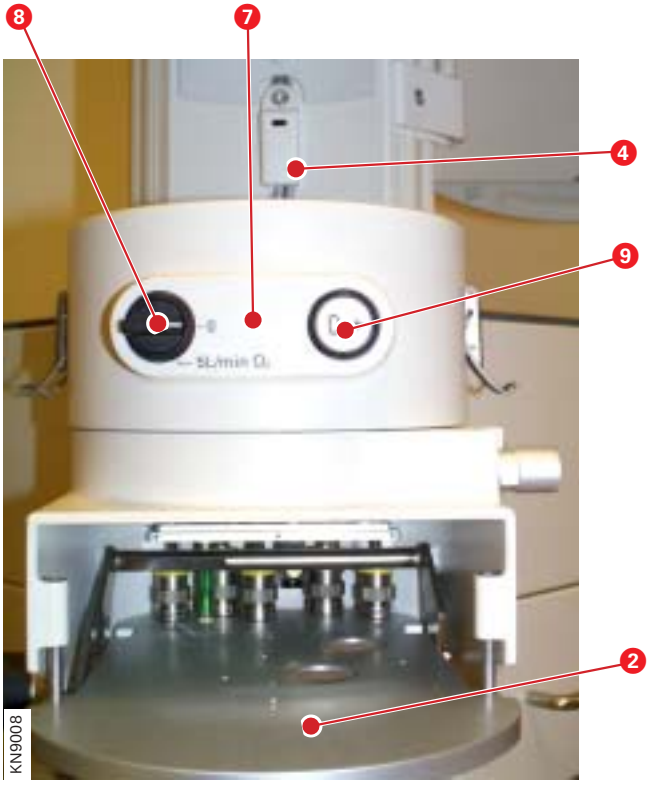
Vaporizers for the following anesthetic agents are available:

- Halothane
- Enflurane
- Isoflurane
- Sevoflurane
- Desflurane.

Handle the vaporizers with care when filled with anesthetic liquids. Never turn them upside down or lay them sideways.

2

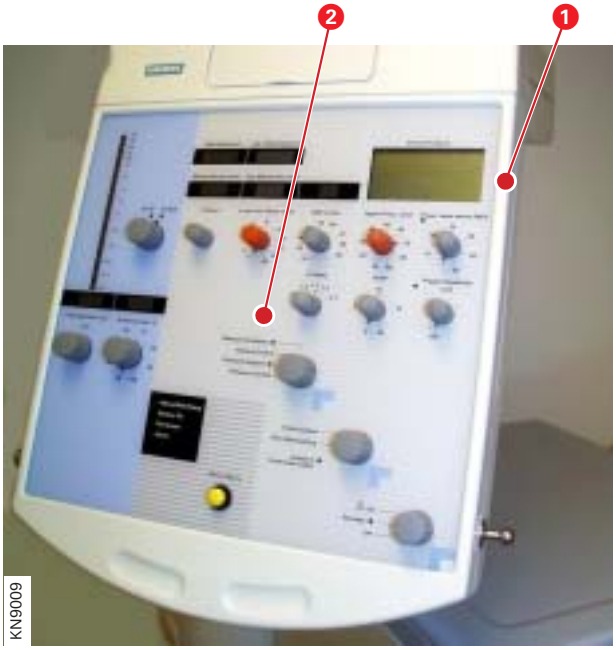




Patient unit

The patient unit controls the gas flow to and from the patient. The main functions are:

1. Patient cassette. Removable unit containing mushroom valves, expiratory flow transducer, inspiratory and expiratory unidirectional valves and the APL valve. The patient tubes and the manual breathing bag are connected to the patient cassette.
2. Support plate for patient cassette. There are five solenoid valves and a mechanically controlled cut-off valve included in the support plate.
   The solenoid valves are electrically connected to PC 1755 PATIENT CASSETTE VALVE CONTROL. All these parts are protected by a cover plate.
3. Bag-in bottle. The breathing bellows and the bellows container are connected to the breathing system when Circle System is selected.
   A bellows position sensor (4) including PC 1766 BNB SENSOR is mounted on the cart.
5. The CO_2 Absorber purifies the rebreathing gas when Circle System is selected.
6. Auxiliary fresh gas outlet to be used in combination with external breathing systems.
7. The section Instant O_2 supply contains the:
   - Emergency O_2 switch (8) marked **5 L/min O_2**. When switched on, it secures a continuous gas flow from the O_2 gas supply of approx. 5 l/min. This function enables manual ventilation, e. g. in case of ventilator malfunction.
   - O_2 Flush push-button (9) marked **O_2+**. A gas flow of 35 – 75 l/min (depending on the O_2 supply pressure) will be delivered to the breathing system as long as this button is pressed.



User interface

Control panel

The control panel section consists of the:

1. Control panel housing.
2. Front panel mounted onto the Control panel housing. The front panel is available in different language versions.
3. PC 1672 CONTROL PANEL mounted inside the control panel housing. The control panel selectors and potentiometers are connected to PC 1672 CONTROL PANEL.

KION Monitor

The KION Monitor (1) used on the KION workstation is a Siemens Patient Monitor, SC 7000, SC 9000 or SC 9000XL. The KION Monitor, that is mounted on the DOCKING STATION™, will make the KION workstation an integrated part of the PICK AND GO™ concept.

The KION Monitor is used not only for clinical information but also for displaying technical information during pre-use check, calibration and troubleshooting of the KION workstation.

For information regarding the KION Monitor, refer to the User's guides and the Service Manuals for the Siemens Patient Monitors.

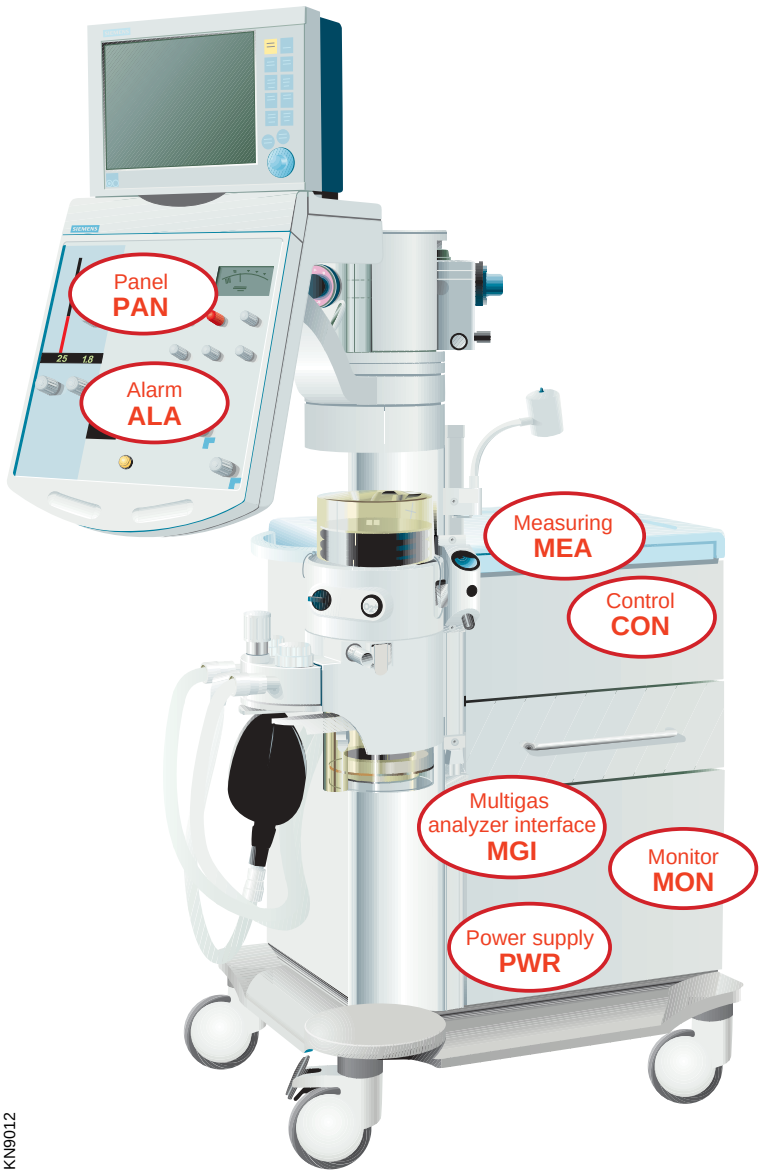
2

Electronic structure

General

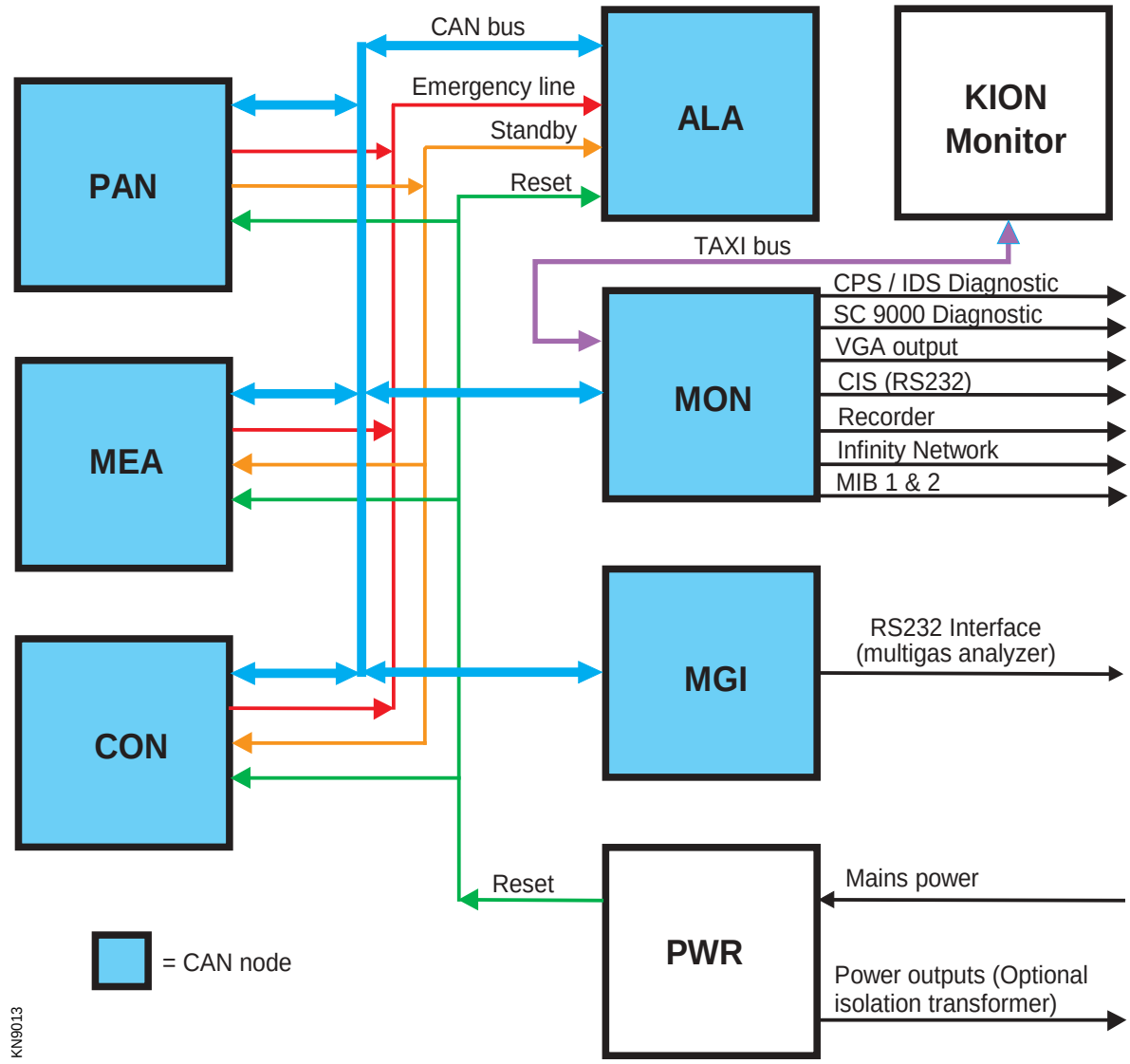
The KION software can be divided into the following functional electronic subsystems:

- Panel (PAN)
- Alarm (ALA)
- Measuring (MEA)
- Control (CON)
- Multigas analyzer interface (MGI)
- Monitor (MON)
- Power supply (PWR).



Internal communication

The diagram below shows the basic electrical signals between the different electronic subsystems:



CAN bus

Internal communication via CAN bus protocol (CAN = Controller Area Network).

The CAN bus is a simple two-wire differential serial bus system. The CAN bus operates in noisy electrical environments with a high level of data integrity.

TAXI bus

Communication between the CPS/IDS and the KION Monitor.

Emergency line

Digital signal in separate cabel for alarm distribution in case of CAN bus malfunction.

Standby

Digital signal in separate cabel that activates standby functions.

Reset

Digital signal in separate cabel that ensures a controlled start of the microprocessors at a stable voltage level.

2

Panel (PAN)

The PAN-software is stored in an exchangable program memory (PAN-PROM) mounted on PC 1672 CONTROL PANEL.

The main functions of the PAN subsystem are:

- Forwarding panel settings to CON and MEA.
- Displaying set and measured parameters.
- Barometer calibration and forwarding of barometric pressure.
- Adjusting display brightness.
- Supervision of ALA.
- Control panel check (displays and LEDs) at startup.

Alarm (ALA)

The ALA-software is stored in an exchangable program memory (ALA-PROM) mounted on PC 1672 CONTROL PANEL.

The main functions of the ALA subsystem are:

- Alarm gateway; transfers alarms from the different subsystems to the MON subsystem for presentation on the KION Monitor.
- Alarm backup in case of communication error with the KION Monitor.
- System release at power-up.
- Supervision of power supply.
- Supervision and calculation of battery capacity.
- Supervision of system status (OFF/Standby/ON).
- Supervision of internal CAN-nodes.
- Handling E2PROM-data concerning system configuration.
- Mains/battery indication on the control panel.
- Alarm silencing on the control panel.

Measuring (MEA)

The MEA-software is stored in an exchangable program memory (MEA-PROM) mounted on PC 1737 MEASURING.

The main functions of the MEA subsystem are:

- Measuring, calculation and supervision of expiratory flow (minute and tidal volume).
- Measuring and supervision of airway pressure (software and hardware detection).
- Supervision of gas supply pressure.
- Heating, calibration and zeroing of the expiratory flow transducer.
- Calibration of pressure transducers.
- Supervision of "Disconnect".

The measured values are distributed to the correct subsystem via the CAN bus.

MEA handles alarm detection and forwards the alarms to the ALA subsystem. Alarm limits are either constant values or values set on the control panel.

Multigas analyzer interface (MGI)

The MGI-software is stored in an exchangable program memory (MGI-PROM) mounted on PC 1747 CAN/RS232 INTERFACE.

The main functions of the MGI subsystem are:

- Protocol converter between KION (CAN) and the multigas analyzer (RS232).
- Startup of multigas analyzer.

Monitor (MON)

The Monitor (MON) subsystem includes the:

- COMMUNICATION INTERFACE, CPS alt. IDS Network PCB.
- PC 1754 CONNECTOR alt. PC 1856 CONNECTOR.
- PC 1761 MIB CONNECTOR alt. PC 1843 MIB CONNECTOR 2.
- KION Monitor.

The COMMUNICATION INTERFACE is also included in the Siemens Communication Power Supply (CPS) alt. Infinity Docking Station (IDS) module.

The software in the COMMUNICATION INTERFACE , CPS-SW alt. IDS-SW, and KION MONITOR-SW in the KION Monitor is installed from a PC Card via the KION Monitor.

The main functions of the MON subsystem are:

- Displaying patient parameters and wave forms.
- Displaying gas supply pressures.
- Displaying set and measured gas concentrations.
- Displaying alarms.
- Handling external communication.

Control (CON)

The CON-software (CON-SW) is stored in a FLASH-PROM on PC 1730 CONTROL. New versions of the CON-SW can be installed either by replacing PC 1730 or by using the Software download tool.

The main functions of the CON subsystem are:

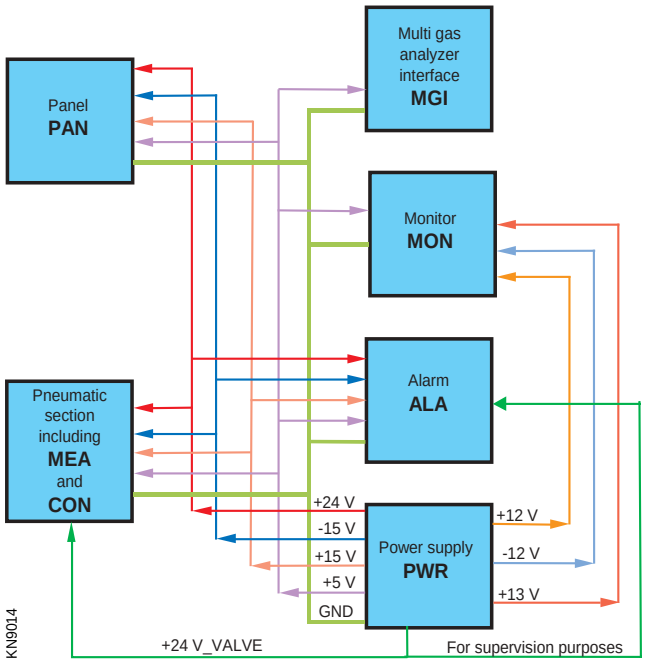
- Control of breathing systems.
- Control of ventilation modes.
- Control and measuring of fresh gas flow including gas mixture selection (O_2/AIR, O_2/N_2O).
- Calculation of inspiratory flow.
- Calculation of spontaneous breathing frequency.
- Conversion of panel settings and feedback to panel.
- Controlling the ”Pre-use check” and the ”Calibration” sequences.
- Control of all electromagnetic valves.

Power supply (PWR)

The Power supply (PWR) subsystem includes the:

- AC/DC Converter.
- Internal battery.
- PC 1753 DC/DC CONVERTER.
- PC 1675 POWER SUPPLY.
- Isolation transformer (if connected).
- Control of power-up and power-down sequences.

The Power supply subsystem is responsible for converting mains power and battery power to the voltage levels requested by the system. Power supply will also supply these voltages to the electrical parts within the system.



Notes

Only personnel trained and authorized by Siemens shall be permitted to perform installation, service or maintenance of the KION / KION-i workstation.

Make sure to prepare the KION / KION-i workstation properly before disassembling and assembling. Refer to section "Hazard notices" in chapter "Important".

Any service or maintenance must be noted in a log book.

Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

After any installation, maintenance or service intervention in the KION / KION-i, perform a "Calibration" and a "Function check".
Refer to the "KION / KION-i anesthesia workstation – Operating Manual" for details.

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About this chapter

The Description of functions is divided in two levels:

- ***Basic principles*** *– Basic principles containing a survey of the function. This text is written with an italic typeface. The text refers to the diagram "Basic principles" in chapter "Diagrams".*
- **Enhanced information** – Enhanced information about the function. Normal typeface is used in this text. This text refers to the following diagrams in chapter "Diagrams":
  - – Pneumatic block diagram
  - – Electronic interconnection.

Text written in SMALL CAPS refers to block names in the diagrams mentioned above.

Battery drawer

The battery drawer contains functions for power supply and communication.

1. AC/DC Converter

The AC/DC CONVERTER, containing the mains power rectifier and the transformer, is a complete unit that is mounted on the Power & Communication interface casing. The AC/DC CONVERTER is electrically connected to PC 1675 POWER SUPPLY.

There are two mains power inlet fuses in the AC/DC CONVERTER. The fuses and the AC/DC CONVERTER FAN are the only spare parts available for the AC/DC CONVERTER.

The AC/DC CONVERTER FAN pulls cooling air into the converter compartment. If the fan fails, the signal FAN_FAIL generates a diagnostic log message.

If the AC/DC CONVERTER is overheated (above +90°C / 194°F), e. g. due to fan failure, the AC/DC CONVERTER will be disabled. The KION / KION-i workstation will then be power supplied by the INTERNAL BATTERY. When the AC/DC CONVERTER cools down, it will automatically be enabled.

Technical data for the AC/DC CONVERTER:

- AC/DC CONVERTER input: 100 – 240 V AC, 50 – 60 Hz.
- AC/DC CONVERTER output: Max. 400 W, output voltage level 21–30 V DC controlled by an analog signal from the Charging/Discharging control block on PC 1675 POWER SUPPLY.
- Fuses: T 6.3 AL / 250 V AC (2 pcs).

2. Internal battery

The INTERNAL BATTERY (two serial connected 12 V sealed lead acid batteries) supplies the KION / KION-i workstation with backup power for min. 30 minutes with full charged battery.

The INTERNAL BATTERY is used as an internal 24 V backup. The batteries are rated 12 V, approx. 24 Ah.

The INTERNAL BATTERY is continously charged when the KION / KION-i workstation is connected to mains power. Charging time for empty batteries is approx. 6 hours.

The actual INTERNAL BATTERY capacity is continously displayed on the KION Monitor. The battery capacity indication, bargraph with %, is related to actual battery voltage. "100%" is indicated when trickle charge level is reached (fully charged).

The following applies concerning battery voltage supply:

- Battery voltage supply is used as soon as the AC/DC CONVERTER voltage is less than the battery voltage (e.g. if the power consumption is too high).
- If the AC/DC CONVERTER output voltage is below 19 V (e.g. at loss of mains power), a "Switching to battery" alarm indicates that battery voltage supply is in use.
- First battery alarm "Limited battery capacity" is activated when battery voltage reaches below 23 V (22 V if an EXTRA INTERNAL BATTERY is connected). These voltage levels correspond to "20%" indicated.
- Second battery alarm "No battery capacity" is activated 10 minutes after first battery alarm or when battery voltage is below 22 V (21.5 V if an EXTRA INTERNAL BATTERY is connected). These voltage levels correspond to "0 %" indicated.
- All functions will be cut off when battery voltage reaches below 21 V.

Battery capacity indication and alarms are generated via the ALA power supervision function.

Service interval for the INTERNAL BATTERY:

- The INTERNAL BATTERY must be checked during the "Twelve months maintenance".
- The INTERNAL BATTERY must be replaced every three years. After replacement, allow the batteries to recharge before clinical use of the KION / KION-i workstation.

The lifetime of the INTERNAL BATTERY is reduced if it is used frequently to supply the KION / KION-i workstation with operating power or if the battery temperature is above +50°C (122°F) e. g. due to BATTERY DRAWER FAN failure. In such case, it is recommended to check the INTERNAL BATTERY with shorter intervals than 12 months.

Batteries (spare parts) are not supplied by Siemens. They must be purchased locally. Tested batteries for use in the KION / KION-i workstation are listed below. No other batteries must be used.

- **CSB EVX-12260** (http://www.csb-battery.com)
- **Newmax FNC 12240** (http://www.newmaxbattery.co.kr)
- **Power-Sonic PS-12260 NB** (http://www.power-sonic.com)
- **Hitachi HP24-12**

For further information regarding the batteries and battery suppliers, refer to the Internet address stated at each battery type above or to the Siemens Medical Solutions, Customer Service Intranet-Portal at http://cs.med.siemens.de.

3. Extra internal battery (optional)

EXTRA INTERNAL BATTERY (two serial connected 12 V sealed lead acid batteries) for extended backup time. Gives, together with the INTERNAL BATTERY, a total backup time of approx. 120 minutes with full charged battery.

For information regarding battery type, function and service interval, see section 2. "Internal battery" above.

There are two versions of the battery cable; one version to be used if a standard INTERNAL BATTERY is connected and one version to be used if an EXTRA INTERNAL BATTERY is connected. Thus, if an extra EXTRA INTERNAL BATTERY is installed, the battery cable must be replaced.

4. Power & Communication Interface

The following functions are included in the POWER & COMMUNICATION INTERFACE:

- *Communication ports – PC 1754 CONNECTOR alt. PC 1856 CONNECTOR.*
- *PC 1761 MIB CONNECTOR alt. PC 1843 MIB CONNECTOR 2.*
- *COMMUNICATION INTERFACE, CPS network PCB alt. IDS network PCB.*
- *PC 1747 CAN/RS232 INTERFACE.*
- *PC 1753 DC/DC CONVERTER. Generates +12 V, +13 V and a fused +24 V for power supply of the multigas analyzer.*
- *PC 1675 POWER SUPPLY. Voltage supply and battery charge/capacity check. Generates +15 V, - 15 V, +5 V and 24 V for the KION system.*
- *BATTERY DRAWER FAN.*

PC 1754 Connector / PC 1856 Connector

Communication ports for connecting the KION / KION-i workstation to network, service options, etc. The communication ports are integrated parts of the PC board.

There are two versions of the PC board:

- PC 1754 CONNECTOR for KION with CPS.
- PC 1856 CONNECTOR for KION / KION-i with IDS.

Pin configuration and signal names can be found in chapter "Diagrams".

PC 1761 MIB Connector / PC 1843 MIB Connector 2

Converts monitoring parameters to MIB protocol. MIB = Medical Information Bus.

There are two versions of the PC board:

- PC 1761 MIB CONNECTOR for KION with CPS.
- PC 1843 MIB CONNECTOR 2 for KION / KION-i with IDS.

Pin configuration and signal names can be found in chapter "Diagrams".

Communication interface

There are two versions of the COMMUNICATION INTERFACE board:

- For KION with S/N 03645 or lower: PC A101CPS NETWORK PCB including the small PC A301 MONITOR OPTION AND SETUP MEMORY BOARD. These PC boards are also included in the Siemens patient monitor Communication/Power Supply module.
- For KION / KION-i with S/N 03646 or higher: PC A110 IDS NETWORK PCB and PC A120 CAN/MIB. This PC board is also included in the Siemens Infinity Docking Station module.

The CPS/IDS software (CPS-SW alt. IDS-SW) is installed from a PC Card via the KION Monitor.

For further information regarding the Communication/ Power Supply module or Infinity Docking Station module, refer to e. g. SC 7000/9000XL or SC 9000 Service Manuals.

PC 1747 CAN/RS232 Interface

Protocol converter between KION (CAN) and the multigas analyzer (RS232).

The MGI-software is stored in an exchangable program memory (MGI-PROM) mounted on PC 1747 CAN/RS232 INTERFACE.

PC 1753 DC/DC Converter

This description also refers to the block diagram "Power supply – Main functions".

PC 1753 DC/DC CONVERTER is supplied with +24 V from PC 1675 POWER SUPPLY and generates:

- +12 V to connected equipment (lamp, recorder, MIB, CPS/IDS Diagnostic and DuoView).
- +13 V to the KION Monitor.
- A fused +24 V to the multigas analyzer.

There are three fuses on PC 1753:

- F1/PC 1753 = 15 A / 32 V. Cuts the +24 V power supply to the DC/DC CONVERTER 24/12 V which disables the +12 V power supply to connected equipment. No alarm is activated.
- F2/PC 1753 = 15 A / 32 V. Cuts the +24 V power supply to the DC/DC CONVERTER 24/13 V which disables the +13 V power supply to the KION Monitor. The KION Monitor will run on its internal battery and alarm is activated.
- F3/PC 1753 = 7.5 A / 32 V. Cuts +24 V power supply to the multi gasanalyzer. Alarm is activated.

PC 1675 Power Supply

This description also refers to the block diagram "Power supply – Main functions".

The main functions are:

- Generates and distributes +15 V, - 15 V and +5 V to the different KION subsystems. Also generates +12 V and -12 V for the CPS/IDS via linear regulators.
- The Logic & Timing block handles different time delays for voltages at Power On:
  - The input signal MEAS_INHIBIT comes from ALA in order to stop the battery capacity check.
  - The input signal DISABLE_VALVES comes from ALA, CON or MEA in order to disable +24 V_VALVE (stop power supply to gas modules) e.g. at upper pressure alarm.
- Power supply to gas modules, +24V_VALVE, will also be cut at Low battery voltage or at System Off.
- BATTERY DRAWER FAN is power supplied by +24V_FAN. As from KION S/N 01501, this voltage is temperature controlled by an NTC resistor at connector P123. Reduced fan speed up to 25°C (77)°F. Linear increased up to max. speed at 45°C (113°F).
- Power supervision function in the ALA subsystem and PATIENT CASSETTE VALVE CONTROL is power supplied by +24V_PTC.
- Battery status and measure signals from the block Charging/Discharging control is supplied to ALA.
- Power supply of the system will be cut at Low battery voltage or at System Off.

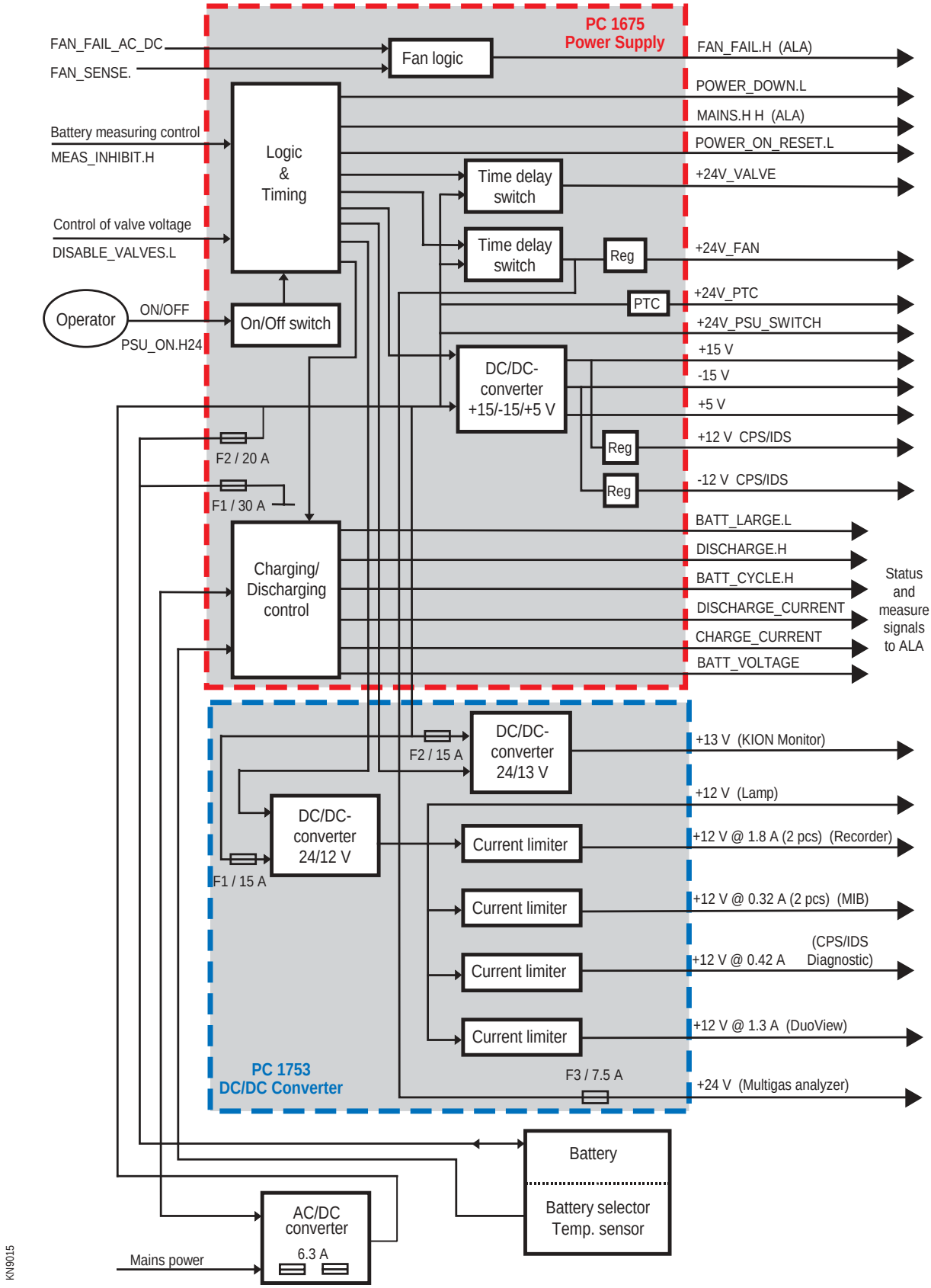
There are two fuses on PC 1675:

- F1/PC 1675 = 30 A / 32 V. Battery short-circuit protection. The internal battery is disconnected and alarm is activated.
- F2/PC 1675 = 20 A / 32 V. Protects the internal battery from failures on PC 1675. The internal battery is disconnected and alarm is activated.

Battery Drawer Fan

The BATTERY DRAWER FAN pulls air out of the battery drawer compartments. If the fan fails, the signal FAN_FAIL generates a diagnostic log message.

If the temperature in the battery drawer compartment is above 45 – 50°C (113 – 122°F), e. g. due to BATTERY DRAWER FAN failure, the function of the multigas analyzer and the lifetime of the INTERNAL BATTERY may be affected.



Block diagram: Power supply – Main functions

Pneumatic section

5. Gas distribution block

Gas supply from hospital central gas supply and/or from gas cylinders are connected to this block. The main functions are:

- *Three gas inlets to connect gas from the hospital central gas supply.*
- *PC 1720 WALL PRESSURE mounted on the block measures the hospital central gas supply pressures.*
- *The breathing gas and drive gas delivered to the KION workstation sub-units are electronically and pneumatically controlled by the GAS SELECTION VALVES.*
- *The two preset pressure regulators mounted on the GAS DISTRIBUTION BLOCK regulates the pressure in the gases delivered to the patient cassettes mushroom valves and to the block INSTANT O_2 SUPPLY.*
- *A number of gas inlets and outlets for connection of the optional BACKUP GAS SUPPLY MANIFOLD, AUXILIARY O_2 SUPPLY and SUCTION EQUIPMENT to the KION Workstation.*

Gas inlets and outlet

The gas inlets are three couplings used to connect gas from the hospital central gas supply.
The design of the gas inlet nipples and the color marking varies according to different national standards.

The gas inlet channels (inside the gas distribution block) are equipped with gas inlet filters and spring loaded one-way valves, OV1 – OV3. The gas inlet filters and the one-way valves must be replaced during the "Twelve months maintenance".

The O_2 outlet is one coupling used to connect optional equipment that requires O_2 supply.
The design of the gas outlet nipple and the color marking varies according to different national standards.

PC 1720 Wall Pressure

There are two main functions on PC 1720 WALL PRESSURE:

- Three pressure transducers including amplifiers. Measures the pressure in the gases connected to the gas inlets (from the hospital central gas supply). There are no tube connections to the transducers, the PC board is mounted firmly onto gas outlets in the GAS DISTRIBUTION BLOCK. The gas outlets are equipped with seals to prevent leakage between the GAS DISTRIBUTION BLOCK and the PC board.
- Valve driver. A drive stage for the gas selection valves EMV6 and EMV7.

Gas selection valves

The different gases delivered to the GAS MODULES are controlled as follows in the GAS DISTRIBUTION BLOCK:

- Gas going to GAS MODULE AIR (N_2O) – BP: Controlled by the solenoid valve EMV6. AIR or N_2O breathing gas depending on settings on the control panel. Cuts automatically the N_2O supply if O_2 supply pressure drops below 220 kPa (2.2 bar). Opens automatically the N_2O supply at O_2 supply pressure above 240 kPa (2.4 bar).
- Gas going to GAS MODULE O_2 – BP: Only O_2. The O_2 breathing gas is delivered directly to the GAS MODULE O_2 – BP and is not controlled by any solenoid valve on the GAS DISTRIBUTION BLOCK.
- Gas going to GAS MODULE DRIVE GAS AIR (O_2): Controlled by the solenoid valve EMV7. Supplies normally AIR but changes automatically to O_2 if the AIR supply pressure drops below 200 kPa (2.0 bar) or if the solenoid valve drive voltage fails.

Pressure regulators

There are two preset pressure regulators mounted on the GAS DISTRIBUTION BLOCK:

- REG1 regulates the pressure in the mushroom valve control gas supply (AIR or O_2 depending on EMV7 mode) used by EMV1 – 5. The preset pressure is 20 kPa (0.2 bar). For adjustment of REG1, refer to the tool "Pressure Tester 0.2 bar Regulator.
- REG2 regulates the pressure of the breathing gas (O_2) to the block INSTANT O_2 SUPPLY. The preset pressure is 320 kPa (3.2 bar).

Backup gas inlets

The GAS DISTRIBUTION BLOCK is equipped with three backup gas inlets used when gases from the optional BACKUP GAS SUPPLY MANIFOLD are connected. These inlets are plugged if not used.

Gas outlets for auxiliary equipment

There are two extra gas outlets on the GAS DISTRIBUTION BLOCK, one for O_2 and one for AIR. These outlets can be used to supply optional equipment, such as AUXILIARY O_2 SUPPLY and SUCTION EQUIPMENT, with O_2 and AIR.

6. Inspiratory control

Controls the gas delivered to the breathing system. The main functions are:

- *The three GAS MODULES. They are basically of the same design and function as the gas modules (inspiratory valves) in the Servo Ventilator 300.*
- *Five safety valves, SV1 – 4 and SV8.*
- *FRESH GAS PRESSURE CONTAINER to create the working pressure for the fresh gas supply.*
- *Inspiratory fresh gas channel that measures and regulates the fresh gas to the breathing system.*

Gas modules

There are two different versions of the gas module:

- Type I recognized by the metal nozzle unit.
- Type II recognized by the plastic nozzle unit.

As from S/N 01501, Type I was replaced by Type II in the production of KION workstation. For information regarding compatibility between Type I and Type II, refer to SpeedInfo 008/02 EM LSS.

If not stated otherwise, this functional description is valid for both versions.

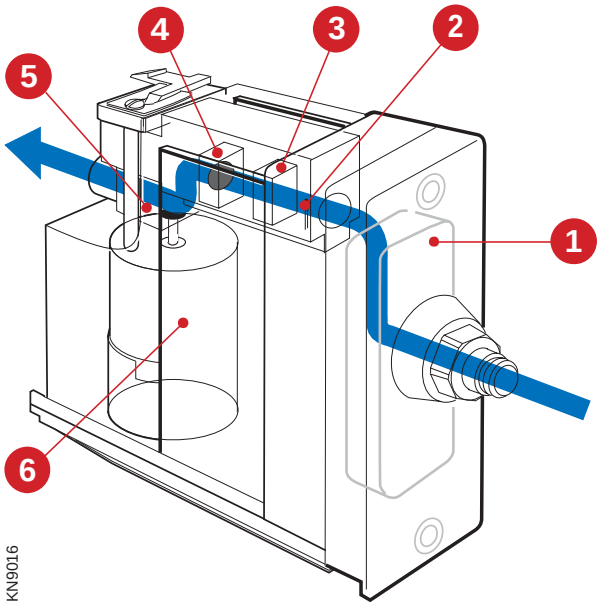
The three GAS MODULES are:

- GAS MODULE AIR (N_2O) – BP supplies AIR or N_2O to the VAPORIZER MAGAZINE.
- GAS MODULE O_2 – BP supplies O_2 to the VAPORIZER MAGAZINE.
- GAS MODULE DRIVE GAS AIR (O_2) supplies AIR or O_2 as drive gas to the REBREATHING SECTION.

The GAS MODULES marked BP are modified to handle the backpressure created when supplying fresh gas to vaporizers. Max. flow from the gas modules modified for backpressure is reduced to 2 l/s. The modification concerns PC boards inside the gas module and the nozzle unit. Without these modifications, the backpressure would disable the diaphragms closing function.

The GAS MODULES are pneumatically connected to the INSPIRATORY GAS BLOCK and electrically connected to PC1765 VALVE INTERCONNECTION.

> The GAS MODULES are factory calibrated.
>
> The adjustment potentiometer located at the top of each GAS MODULE (Type I) must not be adjusted.
>
> Each GAS MODULE must not be disassembled further than described in chapter "Maintenance".



1. Filter
2. Inspiratory valve temperature sensor
3. Supply pressure transducer
4. Flow transducer (Delta pressure transducer and net)
5. Nozzle unit with valve diaphragm
6. Inspiratory solenoid

Air inlet:

Gases from the GAS DISTRIBUTION BLOCK are connected to the inlet tube connectors on the GAS MODULES. The tube connectors and the corresponding tubes have different diametres to prevent faulty gas connections.

The filter housing and the filter cover is provided with matching guide pins. These guide pins prevents mounting the filter cover (with inlet tube connectors) on wrong GAS MODULE.

A non-return valve for the gas inlet is located in the inlet filter cover. This valve will suppress short pressure drops in the gas supply. The non-return valve is also designed to slowly evacuate compressed gas from the GAS MODULE if the gas supply to the GAS MODULE is disconnected.

Filter:

The filter protects the system from particles in the gas delivered to the air inlet. The filter must be replaced during the "Twelve months maintenance".

Inspiratory valve temperature sensor:

The temperature of the supplied gas is measured by the inspiratory valve temperature sensor. This sensor is situated in the gas flow.

The output signal from this sensor is used to compensate for the gas density variations due to temperature.

3

Supply pressure transducer:

The pressure of the supplied gas is measured by the supply pressure transducer.

The output signal from this transducer is amplified. It is then used to calculate the absolute pressure of the gas to compensate for gas density variations due to pressure.

Delta pressure transducer and net:

The gas flows through a net (resistance) which causes a pressure drop. The pressure is measured on both sides of this net and the differential pressure value is then amplified.

Nozzle unit:

The nozzle unit contains a valve diaphragm. The valve diaphragm, controlled by the inspiratory solenoid, regulates the gas flow through the GAS MODULE.

Metal nozzle units (Type I) modified for backpressure must be used together with a small washer that is placed on top of the inspiratory solenoid. This washer will support the diaphragm and distributes the backpressure over a larger area on the diaphragm. This function is integrated in the plastic nozzle units (Type II) and the small washer is not used in these GAS MODULES.

The nozzle units are provided with a mechanical key to prevent that the nozzle unit is mounted into wrong GAS MODULE.

An O-ring and the valve diaphragm (Type I) or the complete plastic nozzle unit (Type II) must be replaced during the "Twelve months maintenance". After replacement, allow the diaphragm to settle during approx. 10 minutes before gas pressure is connected to the GAS MODULE.

Inspiratory solenoid:

The gas flow through the GAS MODULE is regulated by the inspiratory solenoid via the nozzle unit.

The current supplied to the solenoid is regulated so that the gas module will deliver a gas flow according to the front panel settings.

Gas module key:

The GAS MODULES are provided with a mechanical key to prevent that the GAS MODULE is mounted in the wrong slot.

The key consists of a plastic guide mounted underneath the GAS MODULE and a corresponding guide mounted on the pneumatic section base.

Safety valves

The INSPIRATORY CONTROL block contains four safety valves:

- SV1 is a spring-loaded valve preset to open at 600 kPa (6 bar). Protects the vaporizers in case of failure in GAS MODULES AIR (N_2O) – BP or O_2 – BP.
- SV2 is a magnetic valve preset to open at 14 kPa (140 mbar). Will release overpressures created in the BAG-IN-BOTTLE, e. g. if the patient is coughing. Will also protect the BAG-IN-BOTTLE in case of failure in the GAS MODULE DRIVE GAS AIR (O_2).
- SV3 is a magnetic valve preset to open at 18 kPa (180 mbar). Protects the FRESH GAS PRESSURE CONTAINER and the INSPIRATORY FRESH GAS VALVE.
- SV4 is a magnetic valve preset to open at 14 kPa (140 mbar). Protects the patient from high pressure in the fresh gas.
- SV8 is a magnetic valve preset to open at -3.5 kPa (-35 mbar). Protects the pressure transducers from negative pressures created during use of closed suction catheter systems.

The magnetic valves (SV2 – SV4 and SV 8) contain a permanent magnet that affects the metal valve cone. The distance between the magnet and the valve cone is preset to open the valve when the pressure limit is reached.

Do not cover the visable hole in the center of valves SV2 – SV4. If this hole is covered, the valve will not open.

Fresh gas pressure container

The fresh gas from the VAPORIZER MAGAZINE enters the FRESH GAS PRESSURE CONTAINER above the big rubber diaphragm mounted inside the container. A piston, that is pushed up by the constant gas pressure regulated by REG3, affects the diaphragm and the fresh gas is pushed out from the FRESH GAS PRESSURE CONTAINER. The preset pressure 100 kPa (1.0 bar) on REG3 creates a working pressure of 8–15 kPa (80–150 mbar) inside the FRESH GAS PRESSURE CONTAINER.

PC 1752 DIAPHRAGM POSITION SENSOR inside the container, in combination with one magnetic washer inside the piston, indicates the position of the piston, i. e. if the container is almost empty. This level signal is used to enable the GAS MODULES for a flow of fresh gas to the vaporizers. Disabling of the gas modules, when the container is full, is calculated by CON.

The piston and PC 1752 are matched and delivered as a spare part kit. They must be replaced at the same time.

The diaphragm and the piston seal must be replaced during the "Twelve months maintenance".

Inspiratory fresh gas channel

The fresh gas passes:

- The inspiratory fresh gas flow transducer with its amplifier PC 1797 FRESH GAS FLOW (PC 1748 on units with S/N 00125– 01405).
- The INSPIRATORY FRESH GAS VALVE with PC 1751 STEP MOTOR (control function).
- The one-way valve OV4. This valve has a built-in leakage at low pressures and is not appropriate to use during leakage check.

O_2 from the block INSTANT O_2 SUPPLY is connected to the fresh gas channel in the INSPIRATORY GAS BLOCK.

Inspiratory fresh gas flow transducer:

The gas flows through the flow transducer in two parallel channels, one large main channel and one small measuring channel. The main channel is fitted with a wire mesh net, the resistance of which causes a certain proportion of the gas to flow through the measuring channel. The flow through and the differential pressure across the measuring channel acts on a small metal disc ("flag") which, via a metal pin, presses on a small semiconductor strain gauge.

This strain gauge consists of diffused resistors on both sides of an elastic silicone rod. The resistors are connected as a part of a Wheatstone bridge, the other part of which is situated on PC 1797/PC 1748 FRESH GAS FLOW. The more flow in the channel, the higher the pressure on the strain gauge. The change in resistance in the Wheatstone bridge is converted to a corresponding signal voltage.

Cleaning of the flow transducer is described in chapter "Routine cleaning" in the Operating Manual.

Inspiratory Fresh Gas Valve with PC 1751 Step Motor:

The INSPIRATORY FRESH GAS VALVE is operated by a step motor with a special shape slotted cam mounted on the motor shaft.

The gas flows through the fresh gas valve tube (silicone rubber) that is a part of the inspiratory fresh gas channel. The gas flow through the valve tube is then regulated by a movable lever arm that squeezes the valve tube against a fixed arm. This movable arm is attached to the cam and transfers the step motors rotation to a controlled opening position of the valve tube.

The change in flow through the valve tube is micro-step controlled by the step motor. The step motor is controlled by PC1751 that is a part of the step motor assembly.

PC1751 STEP MOTOR is equipped with two LEDs and two photo detectors. When the step motor reaches either end position of the cam slot, the light beam between the LED and the corresponding photo detector is interrupted by a cam screen. The cam screen is a part of the slotted cam mounted on the motor shaft. This will generate an end position signal from PC 1751.

The position of the LEDs / detectors in relation to the cam screen is very important. If a LED / detector gets out of position, or if they fail, this will cause the step motor to "rattle" because end positions are not properly indicated.

When power supply to the INSPIRATORY FRESH GAS VALVE is switched off (or if the power supply fails), the step motor will always end up with the inspiratory valve in fully opened position.

The fresh gas valve tube must be replaced during the "Six months maintenance" and the "Twelve months maintenance".

7. PEEP valve

The expiratory gas flow is regulated by the PEEP VALVE. This valve also regulates PEEP pressure if set on the CONTROL PANEL.

The PEEP VALVE comprises a spring loaded pull magnet acting on a lever arm which squeezes the expiratory valve tube (silicone rubber) against a fixed arm. The more the magnet is activated, the more the valve will move towards the closing position.

When power supply to the magnet is switched off, the valve will be fully opened because of the spring. This ensures that the patient always can exhale through the ventilator at a power failure.

The PEEP valve is controlled by CON. At a PEEP setting, information from the PEEP pressure transducer is used to regulate the valve position during expiration.

The PEEP valve tube must be replaced during the "Six months maintenance" and the "Twelve months maintenance".

8. PC 1733 / PC 1796 Interconnection

The PC 1733 / PC 1796 INTERCONNECTION electrically connects a number of units in the KION workstation. The only electronic functions on this PC board are output filters and PTC resistors.

There are two versions of this PC board:

- PC 1733 on units with S/N 00125–01405.
- PC 1796 on units with S/N 01501 and higher.

Four PC boards are mounted in PC board connectors on the upper side of the PC 1796:

- PC 1730 CONTROL
- PC 1737 MEASURING
- PC 1750 TRANSDUCER
- PC 1797 FRESH GAS FLOW.

With PC 1733 INTERCONNECTION, PC 1797 is not used. Instead, PC 1748 FRESH GAS FLOW is used and connected to PC 1733 via a cable.

The under side of PC 1733/PC 1796, accessible behind a trolley cover, contains cable connectors for:

- Patient unit cable.
- Pneumatic section cable.
- Control panel cable.
- Pressure transducers on the optional BACKUP GAS SUPPLY MANIFOLD.

The PC board inputs/outputs are described in chapter "Diagrams".

9. PC 1730 Control

Controls flow, pressure, composition and concentration in the gas delivered to the patient. All ventilation mode functionality is controlled by this unit.

PC 1730 CONTROL contains a microprocessor that executes the CON-software (CON-SW) that is stored in a FLASH-PROM. New versions of the CON-SW can be installed either by replacing PC 1730 or by using the Software download tool.

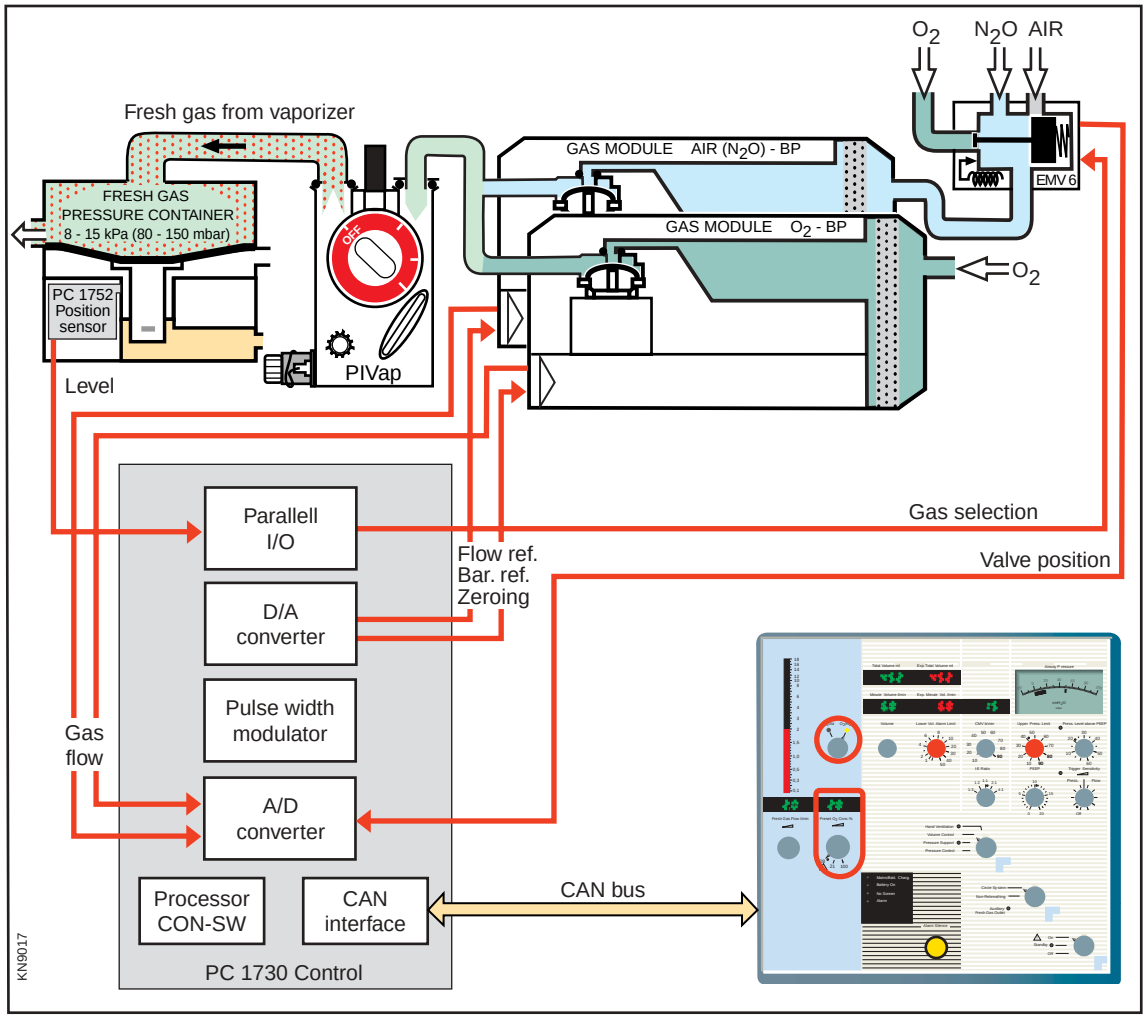
The main functions of PC 1730 CONTROL are:

- *General parameters (used or created by CON).*
- *Fresh gas production (excluding control of anesthetic agent type and concentration).*
- *Inspiratory fresh gas control.*
- *Drive gas for rebreathing.*
- *Regulation of expiration.*

General parameters

Some of the general parameters used or created by CON are:

- **Pressure**: Input pressure signals from the four pressure transducers on PC 1750 are supplied via the A/D CONVERTER for regulation of inspiration and expiration.
- **Timing**: Output Insp. time and Exp. time signals are generated. These are used by MEA to control zeroing of the flow transducers.
- **Fresh gas outlet**: Input signal from the Hall sensor in the AUXILIARY FRESH GAS OUTLET indicates when the valve is opened. This signal is used to light up a LED on the CONTROL PANEL.
- **Pressure alarm**: Input signal from MEA indicating that upper pressure limit is reached. Used to stop inspiration time and immediately start expiration time. This will open the PEEP VALVE and to set the other valves in safe positions.



PC 1730 – Fresh gas production

Fresh gas production depends on the following settings:

- Selection of gas mixture – O_2/Air or O_2/N_2O.
- Preset O_2 concentration.
- Anesthetic agent – type and concentration.

Air/N_2O selection:

Information about gas combination selected on the CONTROL PANEL, O_2/Air or O_2/N_2O, is distributed via the CAN bus to PC 1730 CONTROL.

The electrically and pneumatically operated EMV 6 activates the selection. The switching of EMV 6 is monitored.

N_2O supply is automatically cut if the O_2 supply pressure drops.

Gas Modules:

Two of the GAS MODULES deliver fresh gas to vaporizers according to the O_2 concentration set on the CONTROL PANEL.

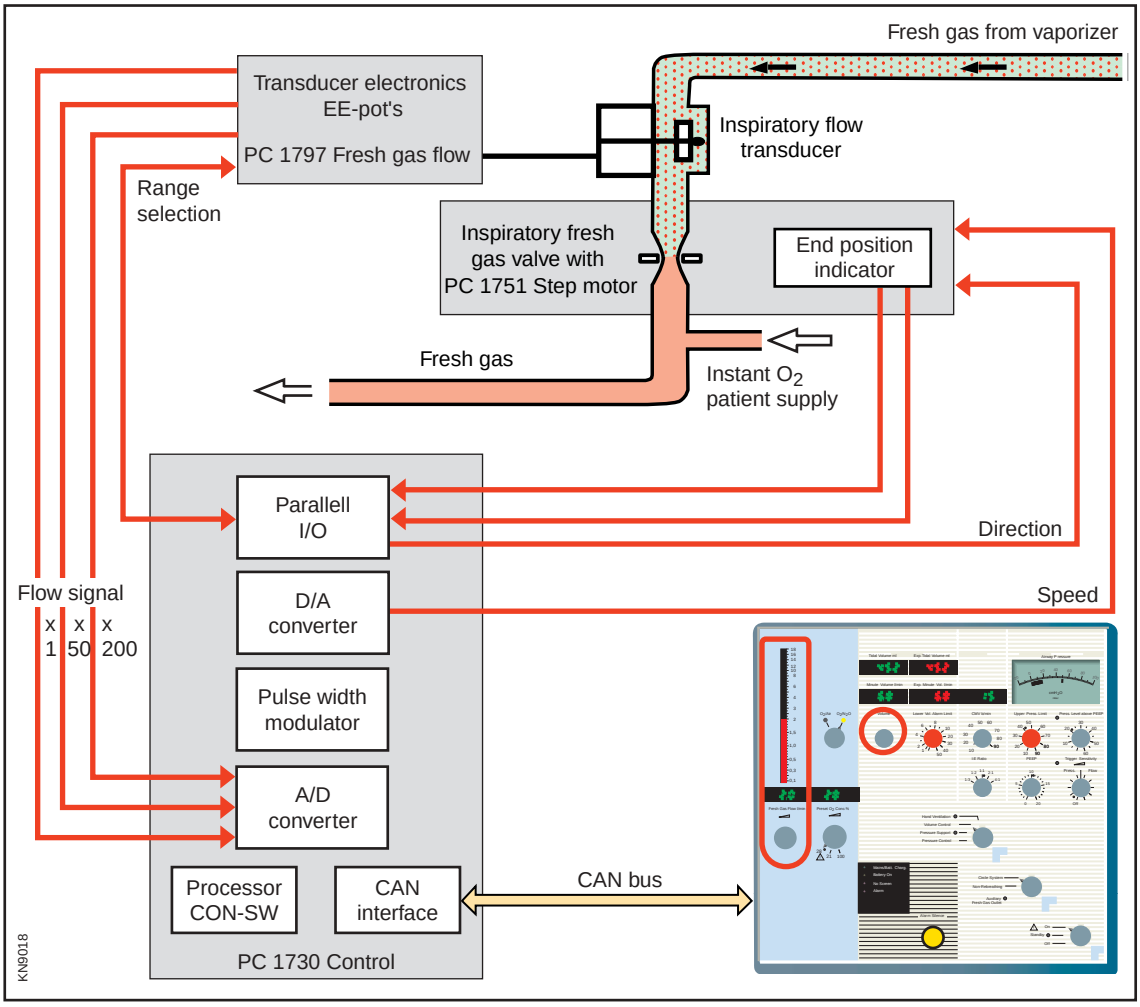
The control signals, delivered from the D/A converter on PC 1730 CONTROL to the GAS MODULES, are:

- Flow reference (desired value – ATP).
- Barometric pressure signal.
- Zeroing of flow transducer.

Each GAS MODULE creates its gas flow signal which is sent back to PC 1730 CONTROL.

Fresh Gas Pressure Container:

The level signal from the DIAPHRAGM POSITION SENSOR indicates if the FRESH GAS PRESSURE CONTAINER is empty. These indications are used to enable the GAS MODULES for a flow of fresh gas to vaporizers.



PC 1730 – Inspiratory fresh gas control

Inspiratory fresh gas control depends on the following settings:

- Volume – When Non-Rebreathing is selected.
- Fresh gas flow – When Circle System is selected.

The total flow of Fresh gas is additionally affected by the Instant O_2 Supply (if O_2 Flush or Emergency O_2 is activated).

Non-Rebreathing:

The Inspiratory Fresh Gas Valve acts as an inspiratory valve which delivers the inspiratory gas flow as set on the Control Panel (Volume).

Circle System:

The Inspiratory Fresh Gas Valve delivers fresh gas flow, as set on the Control Panel, to be added to the expiratory gas that is used for rebreathing (normally after it has been purified in the CO_2 Absorber).

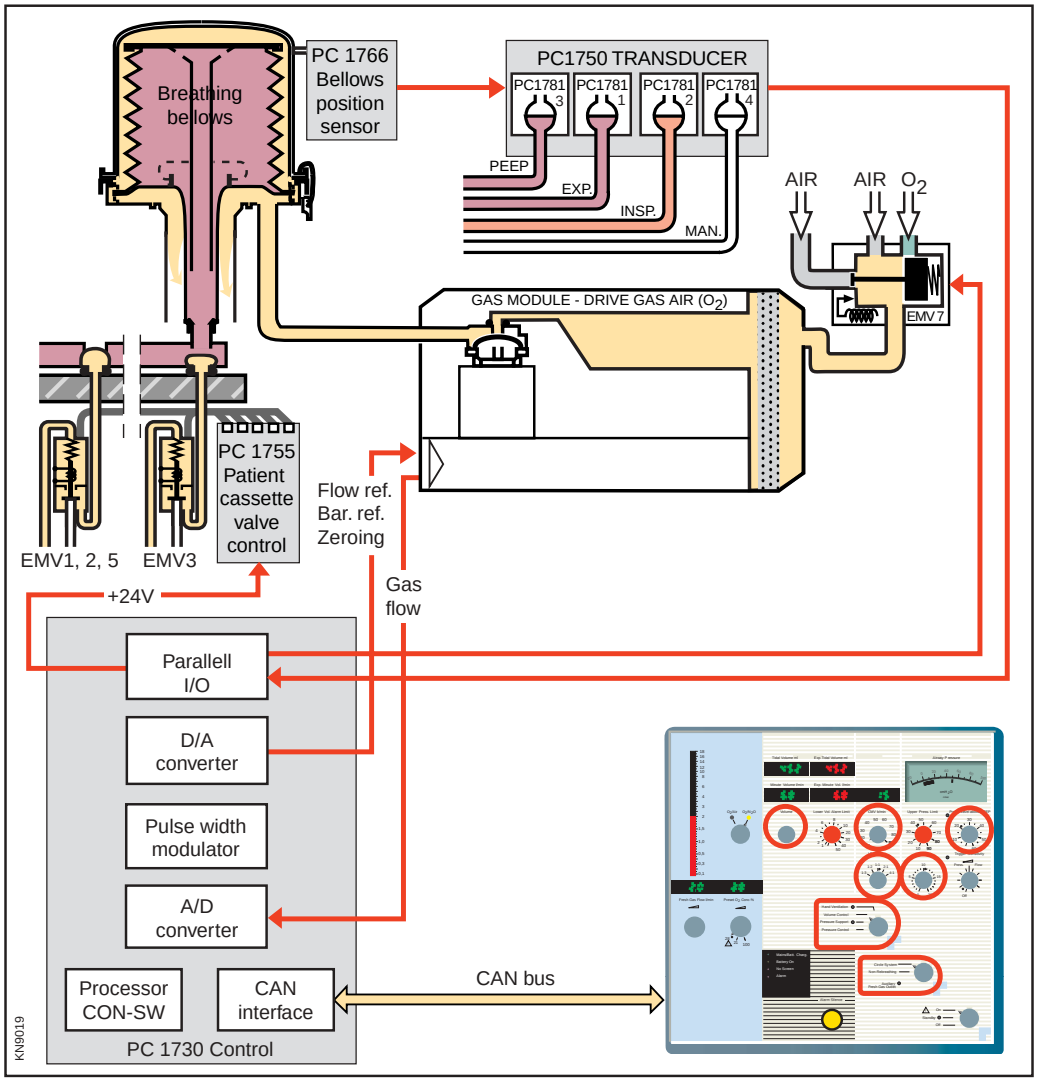
Regulation:

A fresh gas flow reference signal (desired value – ATP) is distributed via the CAN bus. The CON-SW uses this value and the measured flow (actual value) generated by the fresh gas flow transducer via PC1748/PC 1797 Fresh Gas Flow. The signal output from PC1748/PC 1797 is a multiplexer that separates the measured flow signal into 3 different levels of amplification:

- Flow signal x 1
- Flow signal x 50
- Flow signal x 200

A range selection signal is used to select amplification level of flow signal.

This controller calculation results in two control signals (Speed and Direction) which are distributed to the Inspiratory Fresh Gas Valve via PC 1751 Step Motor. If the step motor in the fresh gas valve has reached an end position, these control signals are disabled by an end position signal from PC 1751 which prevents it from moving further in the same direction.



PC 1730 – Drive gas for rebreathing

Type of ventilation depends on the following settings:

- Mode of ventilation.
- Breathing system – Circle System/Non-Rebreathing or Auxiliary Fresh Gas Outlet.
- Volume – When Circle System/VC is selected.
- Press. Level above PEEP – When Circle System/PC and PS is selected.
- Respiratory frequency – CMV (b/min).
- Inspiration time – I:E Ratio.
- Trigger Sensitivity
- PEEP.

Gas module:

The Gas Module Drive gas Air (O_2) delivers drive gas used to compress the Breathing Bellows during inspiration time according to the Volume or Pressure level set on the Control Panel.

The control signals, delivered from the D/A converter on PC 1730 Control to the gas module, are:

- Flow reference (desired value – ATP).
- Barometric pressure signal.
- Zeroing of flow transducer.

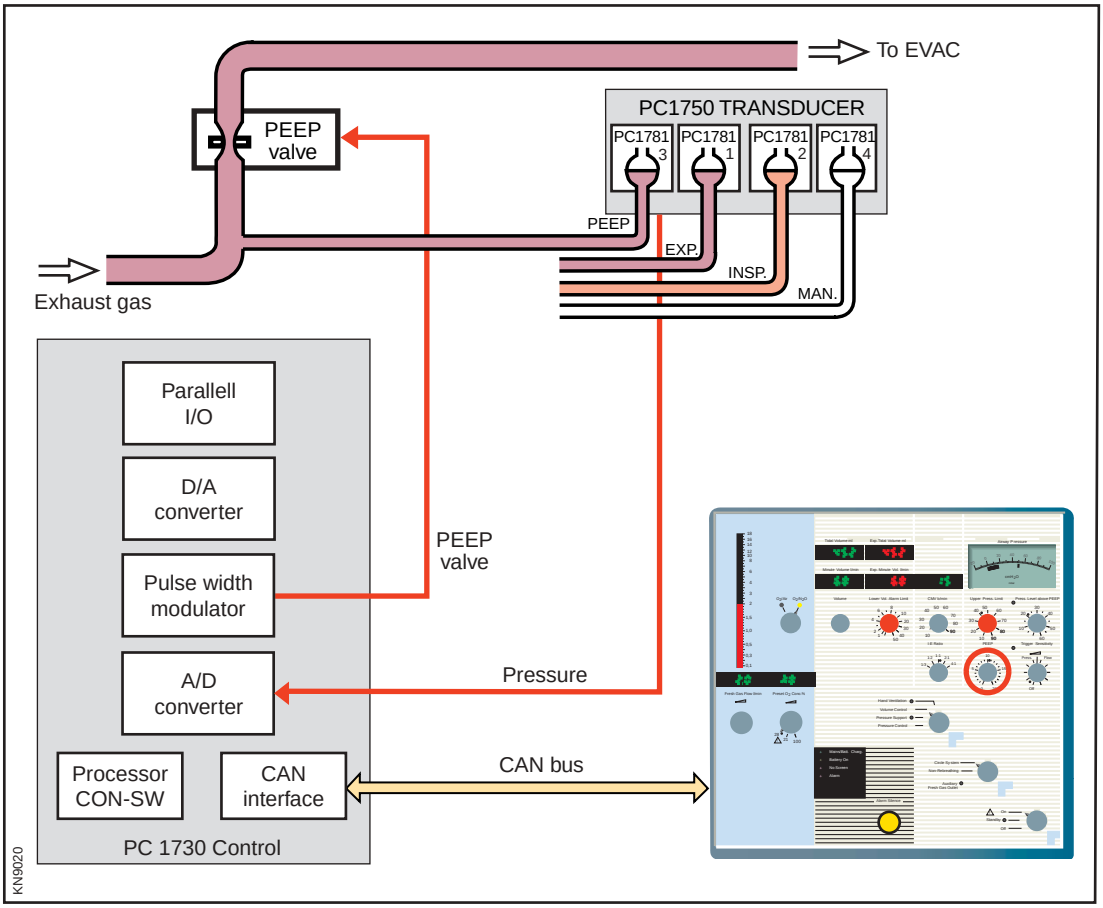
The Gas Module creates its measured flow signal which is sent back to PC 1730 Control.

Bellows Position Sensor:

Position signal from the optical sensor at the Bag-in-bottle container is supplied, via an amplifier on PC1750 Transducer, to the parallell I/O block. This signal is used to change status of EMV2 and EMV3 to allow outlet of excess gas when the Breathing Bellows is full.

Mushroom Valve Control:

The Parallell I/O block supplies signals to activate the electromechanical valves (EMV1 - 5) that control the mushroom valves (MV1 - 5) in the Patient Cassette.



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PC 1730 – Regulation of expiration

Regulation of expiration depends on the following setting:

- PEEP.

The PEEP VALVE is used to control the expiratory gas from the patient. The sampling point for PEEP pressure is located as close to the PEEP VALVE as possible to enhance regulation of PEEP.

The PEEP pressure signal from the PRESSURE TRANSDUCER (actual value) is supplied from PC 1750 to the A/D CONVERTER. The regulation of PEEP (CON-SW) controls the opening of the PEEP valve using the PEEP pressure signal (actual value) and the front panel setting for PEEP (reference value). This regulation also uses the Exp. pressure signal for Exp. channel pressure-drop compensation.

The output signal PEEP valve is supplied to the PEEP VALVE from the PULSE WIDTH MODULATOR. The control signal is pulse width modulated to prevent effects of hysteresis. The pulse lenght affects the position of the valve; the longer the pulses – the more closed is the valve.

Pressure controlled modes:

In pressure controlled modes, the PEEP VALVE is also used to regulate the inspiratory pressure. This is necessary due to the constant fresh gas flow during inspiration.

The regulation is performed in cooperation with the:

- GAS MODULE DRIVE GAS – When Circle System is selected.
- INSPIRATORY FRESH GAS VALVE – When Non-Rebreathing is selected.

10. PC 1737 Measuring

Collects, converts and distributes measured patient related values (expiratory flow, O_2 concentration, airway pressure, gas supply pressures). The values are collected and distributed to other subsystems via the CAN bus.

Detect patient related alarms and informs the ALA subsystem. Alarm limits are either constant values or values set on the control panel.

PC 1737 MEASURING contains a microprocessor that executes the MEA-software stored in the exchangable MEA-PROM.

The main functions are:

- *Expiratory flow measuring*
- *Insp. and Exp. pressure measuring*
- *Gas supply pressure measuring.*

Expiratory flow measuring

The measured expiratory flow value is generated by the EXPIRATORY FLOW TRANSDUCER in the PATIENT CASSETTE. The signal is pre-amplified to a level of 0 – 9 V (9 V = 180 l/min) on PC 1750 TRANSDUCER. The pre-amplified signal Exp. flow is supplied to PC 1737 MEASURING.

To prevent offset in the flow signal, zeroing is done when insp. and exp. time signals have the same status.

The exp. flow signal is then amplified in two different levels:

x 0.5 if the exp. flow is 18 – 180 l/min.

x 5 if the exp. flow is 0 – 18 l/min.

Both amplifiers works continuously, but only one of the amplified signal is selected and used by the processor.

Heating of the EXPIRATORY FLOW TRANSDUCER is controlled by PC 1750 TRANSDUCER. A resistor, 220 Ohms / 6W, is moulded into the transducer housing and is used for heating of the flow transducer.
The transducer is heated to approximately 40°C (104°F) to prevent condensation of water vapour.

Insp. and Exp. pressure measuring

PC 1750 TRANSDUCER is equipped with pressure transducers for airway pressures. The signals from the expiratory and the inspiratory pressure transducers are pre-amplified on PC 1750. The amplified signals, Exp. pressure and Insp. pressure, are supplied to PC 1737 MEASURING.

The signals are compared to the set upper pressure limit and used to activate the upper pressure alarm. There are two different controls of the upper pressure alarm, one SW detected and one HW detected. The pressure is supervised primarily by the SW, but there is also a HW detection at +5 cmH20 above the set upper pressure limit.

- SW detection: When the INSP or EXP pressure is higher than set upper pressure limit, CON orders the SW to evacuate the system and disable the gas modules. CON also reads the HW signal PRESSURE_ERROR.L from MEA as a backup detection.
- HW detection: When the INSP or EXP pressure is +5 cmH2O above the set upper pressure limit, the Upper pressure monitoring HW-block on PC 1737 sets the signal PRESSURE_ERROR.L low and thereby cuts the +24 V power supply to all valves in the system.

The following valves are disabled (both SW- and HW-detection):

- All three GAS MODULES are closed
- INSPIRATORY FRESH GAS VALVE is closed
- All MUSHROOM VALVES except MV5 are opened
- PEEP VALVE is opened.

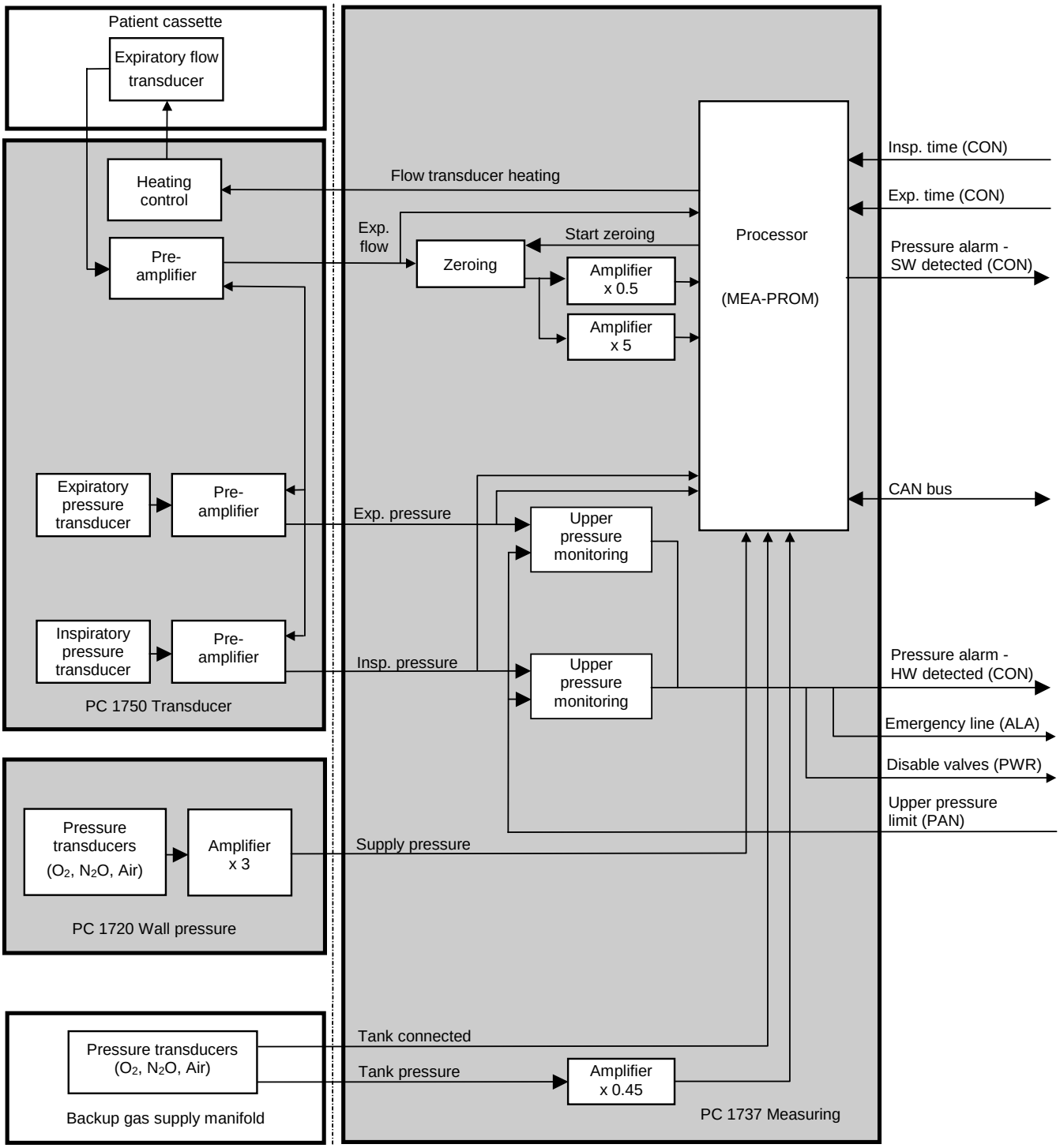
Gas supply pressure measuring

Hospital central gas supply:

Pressures in the connected gases are measured by the pressure transducers on PC 1720 WALL PRESSURE. The signals are amplified and supplied to PC 1737 MEASURING. The amplifiers on PC 1720 are factory calibrated.

Backup gas supply:

Pressure in the connected gas cylinders are measured by the pressure transducers in the BACKUP GAS SUPPLY MANIFOLD. The signal is supplied to PC 1737 MEASURING.



Block diagram: PC 1737 Measuring

11. PC 1750 Transducer

PC 1750 TRANSDUCER is equipped with pressure transducers and pressure amplifiers to measure different gas pressures in the breathing system.

There are two versions of PC 1750 TRANSDUCER:

- PC 1750A and B with four pressure transducers mounted on the PC board. In case of pressure transducer failure, the complete PC 1750 must be replaced.
- PC 1750C (or later) with four PC 1781 PRESSURE TRANSDUCER connected to PC 1750. In case of pressure transducer failure, the concerned PC 1781 can be replaced.

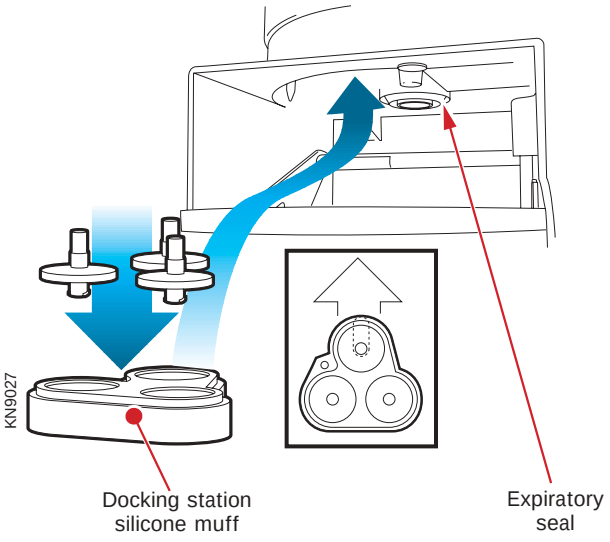
The four pressure transducers are connected to the breathing system with internal tubings. The following gas pressures are measured:

1. Expiratory pressure (EXP)
2. Inspiratory pressure (INSP)
3. PEEP pressure (PEEP)
4. Manual breathing bag pressure (MAN).

PC 1750 TRANSDUCER also contains amplifiers for the:

- Expiratory flow transducer
- Bellows position sensor.

As the gas in the breathing system may be contaminated, the pressure transducers must be protected with filters. The PEEP pressure transducer filter is mounted on the internal tube and connected onto the transducer. The other three filters are mounted into the silicone muff in the patient cassette docking station, see illustration below. All four filters must be replaced during the "Six months maintenance" and the "Twelve months maintenance".



Vaporizer section

12. Vaporizer magazine

The fresh gas to vaporizers, supplied by the GAS MODULES in the PNEUMATIC SECTION, enters the internal channels in the VAPORIZER MAGAZINE. As long as all vaporizers connected to the VAPORIZER MAGAZINE, are set to OFF, the gas just passes the VAPORIZER MAGAZINE and is routed back to the PNEUMATIC SECTION.

If a vaporizer is active (a concentration is set), the mechanical interlocking system inside the VAPORIZER MAGAZINE routes the fresh gas through the active vaporizer and then back to the PNEUMATIC SECTION.

Three PIVap vaporizers can be mounted onto the VAPORIZER MAGAZINE. The magazine contains three mechanically controlled valves; the VAPORIZER SELECTION VALVES 1 – 3. These valves are activated by the concentration knob on the vaporizer. The mechanical interlocking system makes it impossible for more than one vaporizer to be active at a time.

There are two connection nipples for each vaporizer:

- One outlet nipple for fresh gas to the vaporizer.
- One inlet nipple for fresh gas from the vaporizer. There is a one-way valve (OV9 – OV11) in each one of the inlet nipples.

The following parts in the vaporizer magazine must be replaced during the "Twelve months maintenance":

- Two O-rings on the hub inside the vaporizer magazine.
- One-way valve and O-ring inside each inlet nipple.
- O-ring on each inlet and outlet nipple (seals towards the vaporizers).

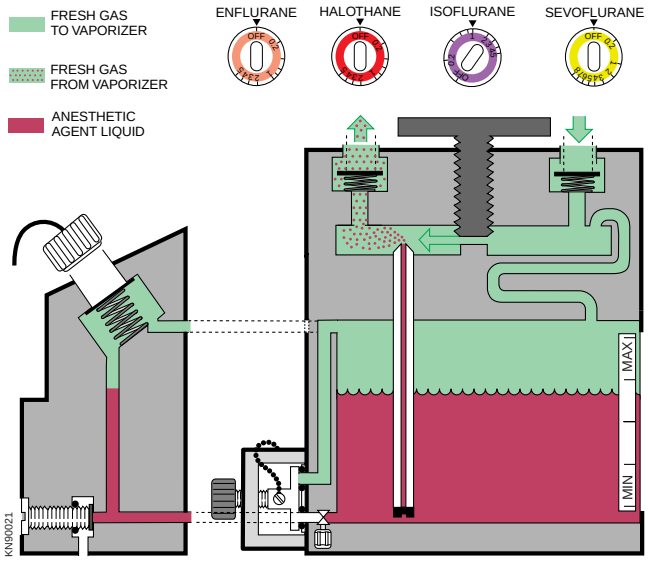
13. PIVap vaporizers

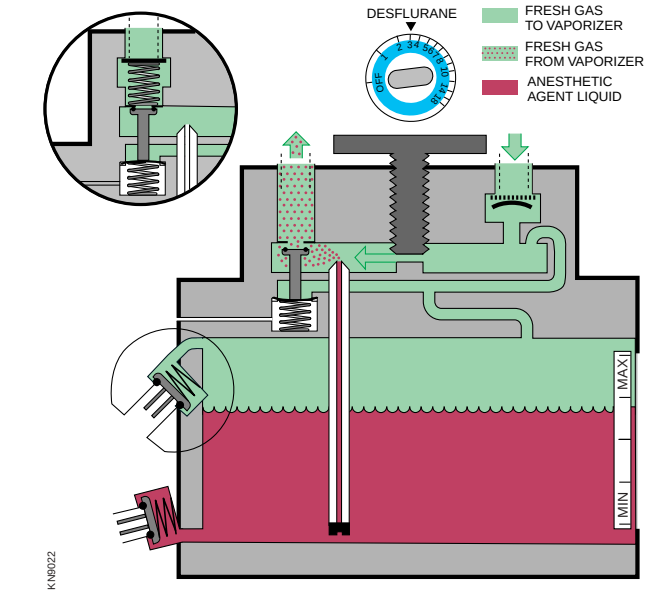
There are PIVap vaporizers available for five different anesthetic agents; Halothane, Enflurane, Isoflurane, Sevoflurane and Desflurane.

A tank inside the vaporizer contains the anesthetic agent. When the fresh gas passes through the vaporizer, the anesthetic agent is injected into the gas. This gas mixture, fresh gas from vaporizer, is then routed back to the PNEUMATIC SECTION.

The PIVap vaporizers, excluding Desflurane, are equipped with a Keyfil mechanism. For Sevoflurane, there is also a QUIK FIL® version available.

The Desflurane vaporizer is equipped with a filling device designed to handle the pressure inside the vaporizer. At room temperature, the pressure inside the Desflurane vaporizer is approx. 110–140 kPa (1.1–1.4 bar).





The anesthetic agent concentration delivered by the vaporizer is depending on the ambient temperature and the filling level in the vaporizer. See ”Technical specifications” in the ”KION / KION-i – Operating Manual” for further information. The concentration should not be set between Off and the first graduation above zero.

When the vaporizer is activated (a concentration is set with the knob), fresh gas from the GAS MODULES enters the vaporizer. In the vaporizer, the gas passes an adjustable throttle valve. The pressure, built up by the flow resistance in the throttle valve, will act upon the anesthetic agent liquid surface in the reservoir. The liquid will then be pressed through the nozzle into the gas stream after which it vaporizes.

The higher the concentration is set on the knob, the higher the pressure created by the throttle will be. This higher pressure will then force more liquid through the nozzle and a higher anesthetic agent concentration will be the result.

A design change will be implemented in the Desflurane vaporizer during 2003. The gas outlet will be equipped with a one-way valve as shown in the illustration.

The vaporizers must be checked during the ”Six months maintenance” and the ”Twelve months maintenance”. One O-ring in each vaporizer valve must be replaced during the ”Twelve months maintenance”.

Handle the vaporizer with care and never turn a vaporizer containing anesthetic agent upside down or lay it sideways.

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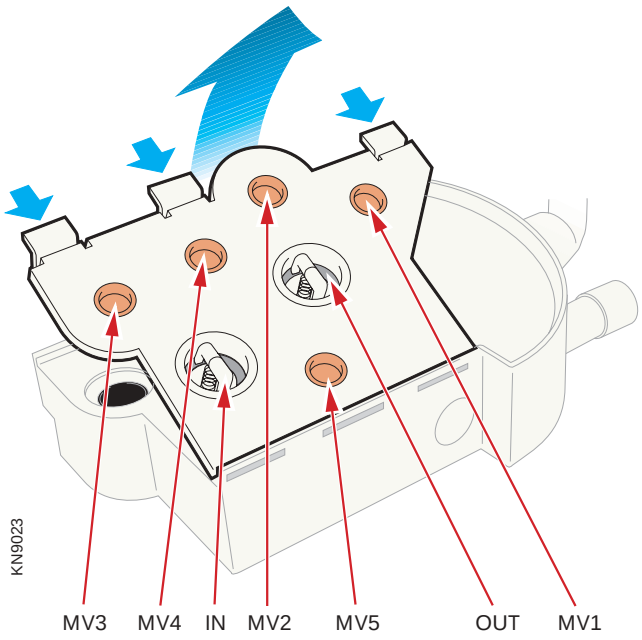


Patient unit

14. Patient cassette

The PATIENT CASSETTE is a removable and easy-to-clean unit. The five mushroom valves and the three uni-directional valves in the patient cassette control the gas flow in the patient unit.

The gas flow is controlled due to:

- *Selected breathing system.*
- *Selected ventilation mode.*
- *Breath cycle phase.*

The expiratory gas flow is measured by the EXPIRATORY FLOW TRANSDUCER.

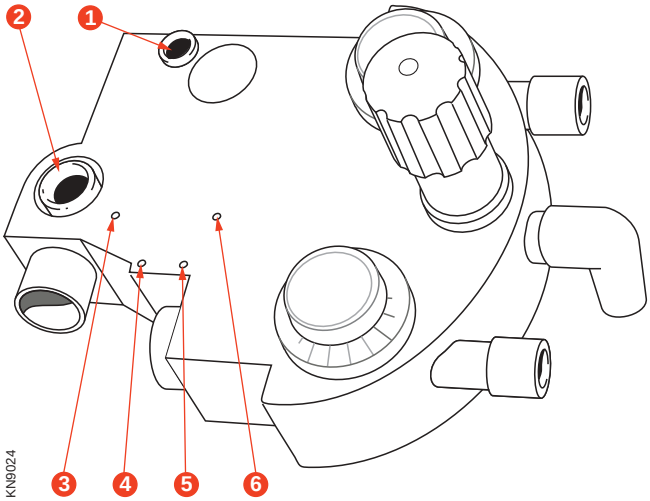
The APL VALVE is used to limit the airway pressure during manual ventilation.

The PATIENT CASSETTE sub-units are:

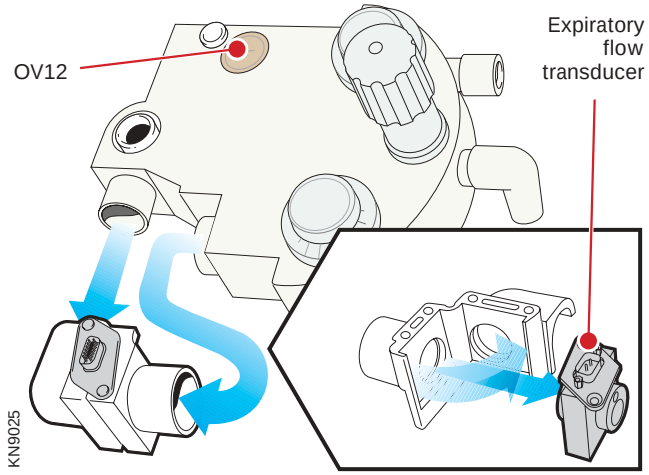
- A removable valve assembly plate with five mushroom valves as indicated in the illustration. The mushroom valves MV1–5 controls the gas flow in the PATIENT UNIT. The mushroom valves are controlled by the five solenoid valves EMV1 – 5 on the SUPPORT PLATE FOR PATIENT CASSETTE.
  - MV1 controls the gas flow from and to the MANUAL BREATHING BAG.
  - MV2 controls the expiratory flow which is evacuated without being used for rebreathing.
  - MV3 controls the gas flow to and from the BREATHING BELLOWS.
  - MV4 controls the rebreathing gas flow towards the patient.
  - MV5 controls the fresh gas delivered to the MANUAL BREATHING BAG.

  There are also connections for the CO_2 ABSORBER on the valve assembly plate. The absorber connections (IN and OUT) are equipped with springloaded cut-off valves that will automatically close the connections when the CO_2 ABSORBER is lowered.

  The valve assembly plate must be replaced during the ”Twelve months maintenance”.

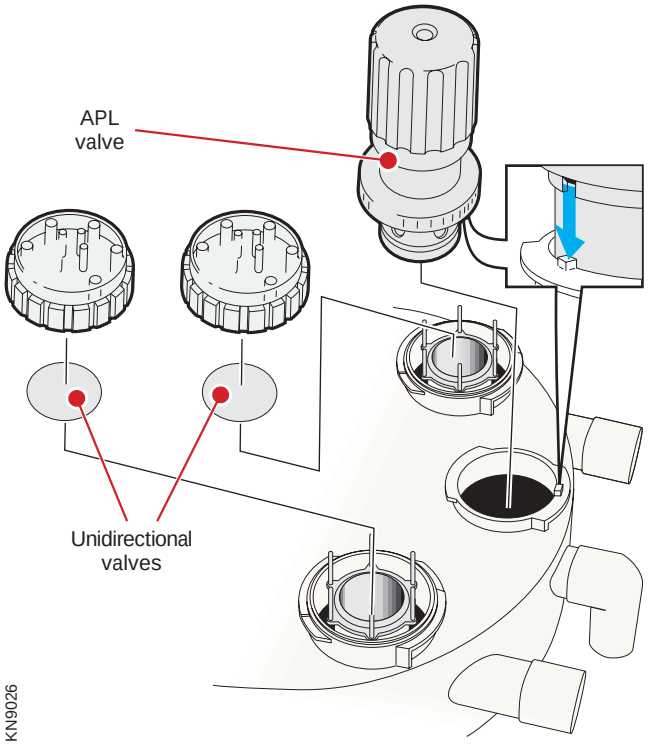


- The holes on the upper side of the patient cassette are intended for:
  1. Fresh gas to the breathing system.
  2. Inner channel: Expiratory gas to/from the BREATHING BELLOWS.
     Outer channel: Expiratory gas to the EVAC outlet (via the PEEP VALVE).
  3. MAN pressure.
  4. Sample gas from the multigas analyzer.
  5. EXP pressure.
  6. INSP pressure.

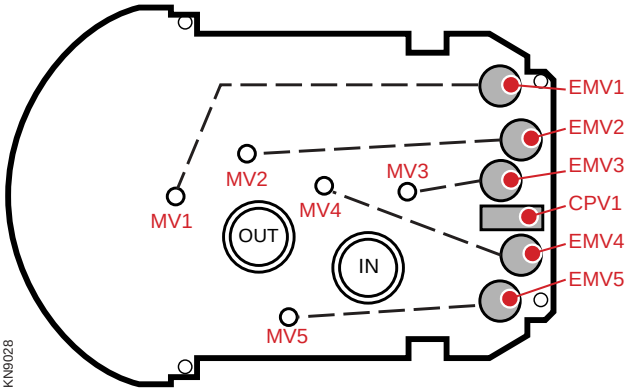


- The EXPIRATORY FLOW TRANSDUCER measures the expiratory gas flow. The EXPIRATORY FLOW TRANSDUCER is of the same type as the FRESH GAS FLOW TRANSDUCER described in section "Inspiratory control" in this chapter.

  The expiratory flow transducer screen (mesh net) must be replaced during the "Six months maintenance" and the "Twelve months maintenance".
- The one-way valve OV12 inside the cassette has an influence on the gas flow during Manual Ventilation in Non-Rebreathing.



- The unidirectional valves for the inspiratory and expiratory gas flows. The valve discs are visible inside the transparent plastic covers and the discs are kept in position by guide pins in the valve seat.
- APL, Adjustable Pressure Limit valve, used during manual ventilation to limit the airway pressure. The APL VALVE can be set between SP (Spontaneous breathing = fully open) and 90 cm H_2O. A noticable change in the force required to rotate the knob occurs at approx. 35 cm H_2O.
- Standard connections for patient tubes and the MANUAL BREATHING BAG.



15. Support plate for patient cassette

The mushroom valves in the PATIENT CASSETTE are pneumatically connected to the five support plate electromagnetic valves via channels in the support plate.

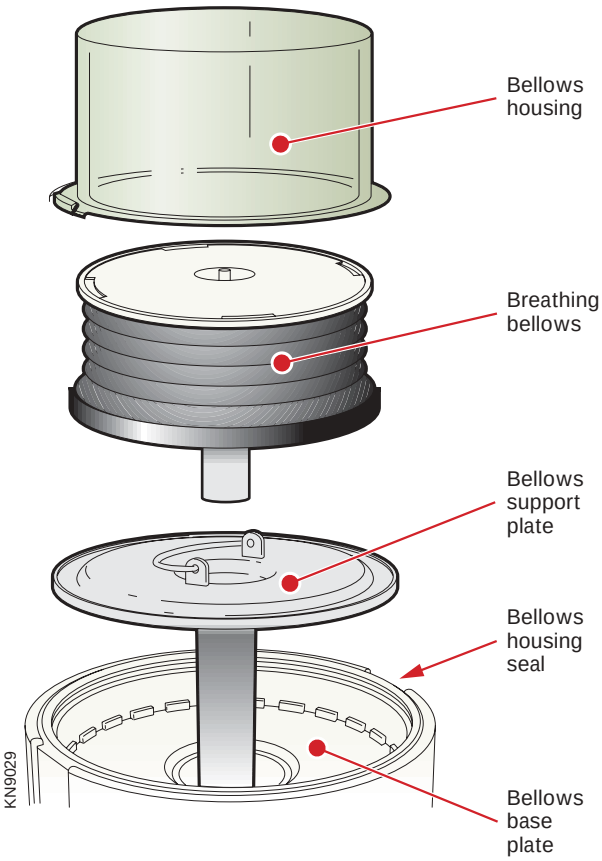
The different channels and the outlet holes in the support plate are shown in the illustration of the support plate.

When the PATIENT CASSETTE is correctly mounted and secured in the cassette docking station, the five mushroom valves MV1– 5 in the cassette can be pressurized and depressurized by the electromagnetic valves EMV1– 5 in the SUPPORT PLATE FOR PATIENT CASSETTE. These valves (EMV1– 5) are electrically connected to PC 1755 PATIENT CASSETTE VALVE CONTROL.

The CONTROL PRESSURE VALVE CPV1 is a mechanically controlled valve that cuts the gas supply to EMV1– 5 when the cassette docking station is lowered.

In Off and Standby, EMV1–5 are all OFF, i.e.:

- EMV1 and EMV4 are deflated.
- EMV2, EMV3 and EMV5 are inflated.

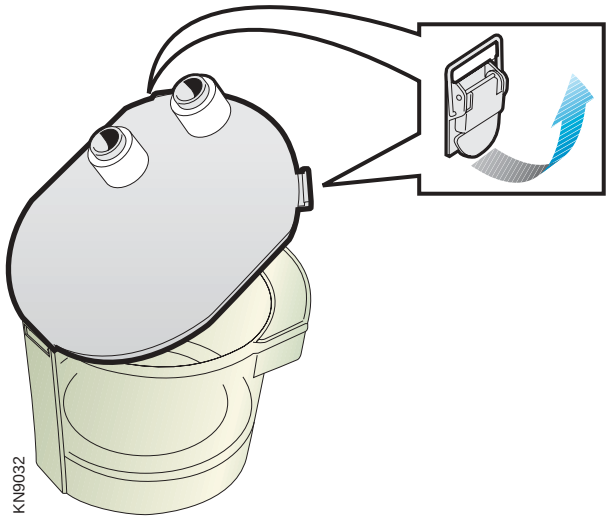


16. Bag-in-bottle

In Circle System, expiratory gas enters the inside of the BREATHING BELLOWS during expiration. During inspiration, the bellows will be squeezed and the expiratory gas inside the bellows will be forced through the CO_2 ABSORBER.

The BREATHING BELLOWS and the bellows housing are connected to the breathing system when Circle System is selected on the CONTROL PANEL.

During expiration, expiratory gas from the patient enters the inside of the BREATHING BELLOWS. During inspiration, drive gas from the GAS MODULE DRIVE GAS will increase the pressure in the Bellows housing (outside the BREATHING BELLOWS). The bellows will be squeezed and the expiratory gas inside the bellows will be forced out to (and through) the CO_2 ABSORBER.

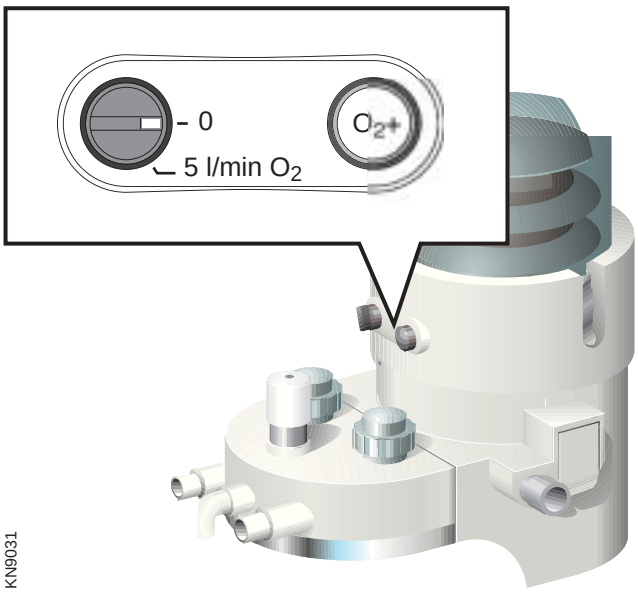

KN9032

17. CO_2 Absorber

In Circle System, expiratory gas is purified in the CO_2 Absorber before it is mixed with fresh gas and delivered to the patient.

Expiratory gas from the Breathing Bellows is routed through the CO_2 Absorber and thus purified before it is mixed with fresh gas from the Inspiratory Gas Block and delivered to the patient.

The CO_2 Absorber is designed to contain 900 ml of absorbent, loose absorbent or pre-packed canisters. Pre-packed is preferred.



KN9031

18. Instant O_2 supply

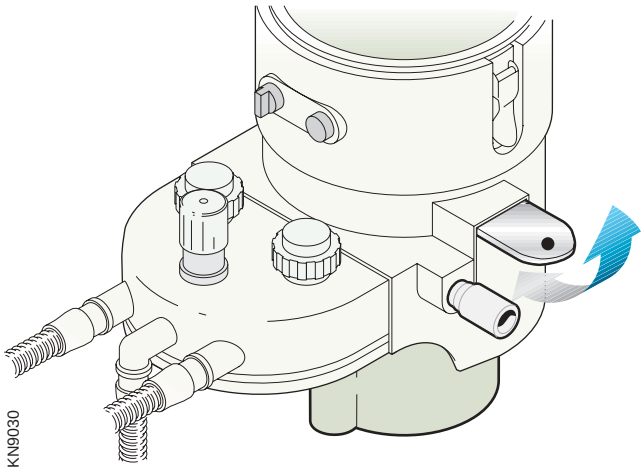
The O_2 Flush and the Emergency O_2 can supply extra O_2 into the fresh gas to breathing system. The Instant O_2 Supply-functions works without power supply and can thus be used in case of power failure.

O_2 with pressure regulated to 320 kPa by REG2 is delivered from the Gas Distribution Block to the Instant O_2 Supply-block.

The block Instant O_2 Supply contains:

- O_2 Flush push-button (marked **O_2+**). Additional O_2 supply of 35 – 75 l/min @ 280 – 600 kPa (2.8–6.0 bar).
- Emergency O_2-selector (marked **5 L/min O_2**). Supplies a continuous O_2 flow of approx. 5–7 l/min for manual ventilation in case of ventilator malfunction. A factory preset throttle valve regulates this flow.

When any of these controls are activated, O_2 is routed to the Inspiratory Gas Block and connected to the fresh gas channel.


KN9030

19. Auxiliary fresh gas outlet

An external breathing system, such as Bain, can be supplied with fresh gas from the Auxiliary Fresh Gas Outlet.

When the auxiliary fresh gas outlet lever is switched to its horizontal position, fresh gas supply to the Patient Cassette is cut off. Fresh gas is then supplied through the auxiliary fresh gas outlet.

A Hall sensor detects the position of the auxiliary fresh gas outlet lever. The yellow auxiliary fresh gas outlet LED on the Control Panel is lit when the outlet is open.

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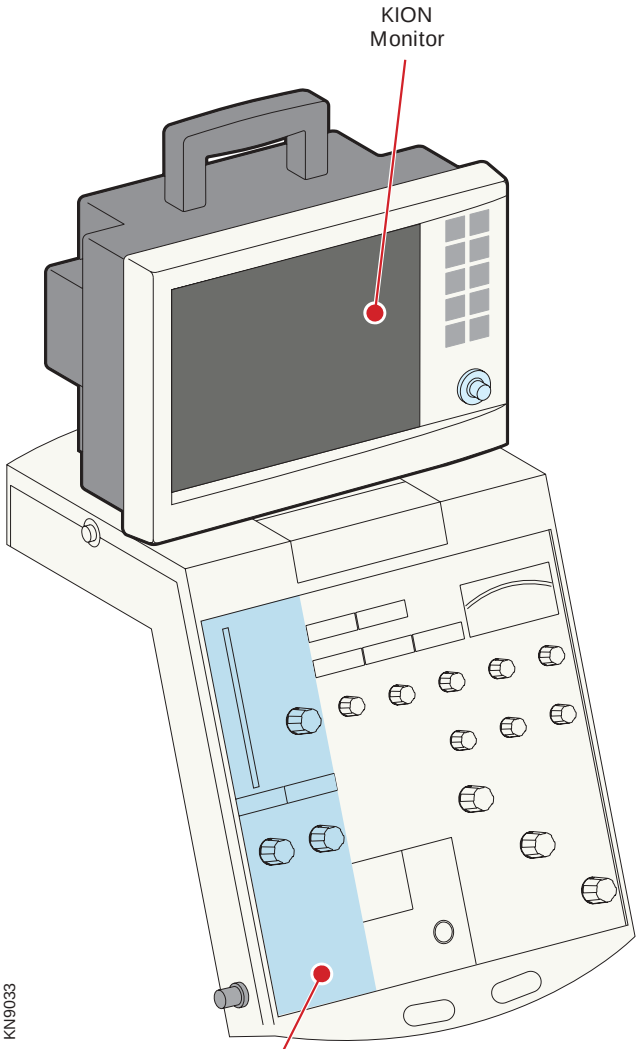

User interface

20. Control panel

Mode selection, fresh gas supply, ventilation parameters and alarms are set on the CONTROL PANEL. The CONTROL PANEL also displays a number of set and measured values.

A description of the control panel functionality can be found in the KION / KION-i workstation – Operating Manual.

The control panel housing contains the PC 1672 CONTROL PANEL (including all displays) and all potentiometers and switches.

A front panel, available in different language versions, is mounted onto the control panel housing.

PC 1672 CONTROL PANEL contains two exchangable PROMs:

- PAN-PROM with the PAN software.
- ALA-PROM with the ALA software.

The main functions of the software are described in chapter ”Introduction” section ”Electronic structure”.

21. KION Monitor

The KION Monitor is a Siemens patient monitor equipped with different levels of functionality. It shows clinical information parameters as configured by the operator.

The KION Monitor used with the KION / KION-i workstation is a Siemens patient monitor SC 7000, SC 9000 or SC 9000XL.

When integrated with the KION / KION-i workstation, the KION Monitor will show hemodynamic parameters and:

- Ventilation parameters (curves and loops).
- Airway pressures.
- Fresh gas flow.
- Gas concentrations.
- Supply gas pressure.

The KION Monitor will also show technical information from the KION / KION-i workstation such as alarms and internal battery capacity.

Further, the KION Monitor is used during the semi-automatic Pre-use Check and Calibration procedures as well as during troubleshooting of the KION / KION-i workstation.

For further information regarding the KION Monitor, see the User's guide and the technical documentation for Siemens Monitors.

Optional equipment

22. DuoView

For additional monitoring capabilities, an optional KION DUOVIEW can be connected to the KION / KION-i workstation.

The KION DUOVIEW is a Surgical Display designed to be an integrated part of the KION / KION-i workstation.

There are two versions of the KION DUOVIEW:

- KION DUOVIEW with S/N 01000 or lower.
- KION DUOVIEW with S/N 01001 or higher.

Both versions have the same functionality.

The knob on the DUOVIEW sets the brightness on the screen. On DUOVIEW with S/N 01001 or higher, this knob can also be used to switch the DUOVIEW On and Off.

The KION DUOVIEW contains the following main parts:

- The Surgical Display Controller. The SDV-SW is stored in a Flash-PROM in the Surgical Display Controller. SW downloading is described in chapter "Service procedures"
- A 10.4 inch color VGA screen.

The DUOVIEW is connected to the KION / KION-i workstation with one connector containing 12 V power supply as well as RS232 communication. The DUOVIEW will start when the KION/KION-i power switch is turned from **Off** to **Standby** or **On**.

During the DUOVIEW start-up sequence, communication with KION Monitor will be established and start-up information will be displayed on the DUOVIEW. The DUOVIEW will be shut off when the KION / KION-i power switch is set to **Off**.

The DUOVIEW is controlled by the KION Monitor. With the DUOVIEW connected (and switched ON), the information will be displayed as follows:

- KION Monitor: A fixed layout containing only ventilation and gas monitoring parameters.
- KION DUOVIEW: Hemodynamic and ECG parameters. Any parameter setting on the DUOVIEW is made on the KION Monitor as described in the User's Guide for the KION Monitor.

23. Multigas analyzer

An optional multigas analyzer can be installed into the KION / KION-i Workstation. There are two different multigas analyzers that can be used:

- *KION MultiGas 2000*
- *KION MultiGas+.*

A sampling tube is connected to the sampling adapter at the Y-piece. A gas pump in the multigas analyzer takes gas samples from the Y-piece. The gas sample is analyzed by the multigas analyzer and the measured values are shown on the KION Monitor.

The gas sample is then returned to the expiratory channel in the PATIENT CASSETTE prior to the EXPIRATORY FLOW TRANSDUCER. Thus, the measured expiratory flow includes the gas sample.

If the temperature in the battery drawer compartment is above 45°C (113°F), e. g. due to BATTERY DRAWER FAN failure, the function of the multigas analyzer may be affected.

For technical information regarding the multigas analyzers, refer to the Service Manual for the concerned unit (KION MultiGas 2000 or KION MultiGas+).

24. Isolation transformer

The purpose of the optional KION ISOLATION TRANSFORMER is to provide the possibility for mains power connection of auxiliary equipment while maintaining the total system earth leakage current below the limits in IEC 60601-1. It provides galvanic isolation from the wall mains outlet.

The ISOLATION TRANSFORMER contains four mains power outlets; 115 V or 230 V, 50 or 60 Hz. Max. outlet is 500 VA and max total leakage current is 100 µA.

A green lamp on the transformer indicates when mains power is available.

The ISOLATION TRANSFORMER is equipped with four fuses:

- Two resetable fuses on the primary side:
  - 6 A on the 115 V transformer.
  - 3 A on the 230 V transformer.
- Two 5x20 mm UL approved fuses on the secondary side:
  - 5 A / 250 V slow-blow on the 115 V transformer.
  - 2.5 A / 250 V slow-blow on the 230 V transformer.

The mains power outlets are designed according to the European standard IEC 320/C14.

For further information, refer to the "KION Optional Accessories Operating Manuals".

25. Backup gas supply manifold

With the optional KION BACKUP GAS SUPPLY MANIFOLD, backup gas cylinders can be connected to the KION / KION-i workstation. The manifold is intended for:

- *N_2O (one gas cylinder)*
- *AIR (one gas cylinder)*
- *O_2 (two gas cylinders)*

The BACKUP GAS SUPPLY MANIFOLD is equipped with PIN-index connections (yokes) for 4 gas cylinders:

- N_2O – One 3-liter gas cylinder. Max cylinder gas pressure is 70 kP x 100 (70 bar) at 35°C (95°F) normally correponding to approx. 50 kPa x 100 (50 bar) at 20°C (68°F) before the pressure regulator.
- AIR – One 3-liter gas cylinder. Max cylinder gas pressure is 200 kP x 100 (200 bar) before the pressure regulator.
- O_2 – Two 3-liter gas cylinders. Max cylinder gas pressure is 200 kP x 100 (200 bar) before the pressure regulator.

The gas inlet channels, inside the yokes, contains inlet filters and one-way valves (OV5 – OV8). The filters must be replaced during the "Twelve months maintenance".

The cylinder gas pressure is reduced by the preset pressure regulators (REG5 – REG7). The gas is then connected to the GAS DISTRIBUTION BLOCK via internal tubing.

The integrated pressure transducers are connected to PC 1733 / PC 1796 INTERCONNECTION, thus the gas pressure in the cylinders will be displayed on the KION Monitor. Alarm is activated if the gas pressure is outside the preset alarm limits.

There are three safety valves (SV5 – SV7) on the manifold; one for each gas. The safety valves are preset to open at a pressure of 6.5 kPa X 100 (6.5 bar).

For further information, refer to the "KION Optional Accessories Operating Manuals".

26. Suction equipment

The optional KION SUCTION EQUIPMENT can be mounted on the KION System.

The main parts of the KION SUCTION EQUIPMENT are:

- SUCTION EJECTOR that creates the vacuum. The SUCTION EJECTOR is powered with drive gas (AIR) from the GAS DISTRIBUTION BLOCK. There is an ON/ OFF switch and a vacuum control knob on the SUCTION EJECTOR.
- SUCTION BOTTLE. The Siemens 1.8 liter bottle is recommended.

For further information, refer to the "KION Optional Accessories Operating Manuals".

27. Auxiliary O_2 supply

The optional KION AUXILIARY O_2 SUPPLY (Auxiliary Oxygen Flowmeter) can be mounted on the KION / KION-i workstation. The flowmeter is supplied with O_2 from the GAS DISTRIBUTION BLOCK.

The flow through the AUXILIARY O_2 SUPPLY is set with the flowmeter knob and the actual flow is indicated by the measuring ball inside the measuring channel. The measuring range of the flowmeter is 0–15 l/min.

For further information, refer to the "KION Optional Accessories Operating Manuals".

28. Gas evacuation

The optional GAS EVACUATION equipment to be used on the KION / KION-i workstation is the KION evac system.

The KION evac system is a Servo Evac 180 equipped with a bracket and a holder arm to be mounted onto the KION / KION-i workstation.

The KION evac system is connected to the EVAC outlet on the KION / KION-i workstation. A Siemens evacuation ejector or the hospital's central vacuum system may be used as an active suction source.

For further information regarding function, operation and technical specifications, see the "Servo Evac 180 – Operating Manual".

29. MiniOX 3000 Oxygen Monitor

Not illustrated in the Pneumatic block diagram or in the Electronic interconnection diagram.

An optional O_2 monitoring device that can be mounted on the KION / KION-i workstation as an alternative to the multigas analyzer if only O_2 monitoring is required.

The main parts of the MiniOX 3000 are:

- Oxygen Monitor
- Connection cable
- T-adapter to be connected to the patient cassette INSP outlet. The adapter holds the O_2 cell and a filter.
- Oxygen sensor (O_2 cell).

For further information regarding function, operation and technical specifications, refer the operating instructions delivered with the MiniOX 3000.

30. Accessory and Monitor shelfs

Not illustrated in the Pneumatic block diagram or in the Electronic interconnection diagram.

A KION / KION-i workstation can be equipped with one of the two optional shelfs Accessory shelf or Monitor shelf.

The shelfs, that is located above the KION top cover, are mounted with a bracket onto the column. The Monitor shelf, intended to carry a heavy monitor, also includes a support leg.

31. Medside Data Station for KION

Not illustrated in the Pneumatic block diagram or in the Electronic interconnection diagram.

The optional Medside Data Station for KION is intended for integration of the Siemens INFINITY MEDSIDE DATA STATION (MDS) with the KION / KION-i workstation. It will facilitate a safe use of a clinical information system as a part of the KION / KION-i workstation.

The MDS/KION Hardware option contains all components required to install the MDS to a KION / KION-i workstation:

- INFINITY MEDSIDE DATA STATION
- MDS box
- Monitor arm with bracket
- Keyboard and keyboard tray
- LCD color monitor.

For further information regarding this device, refer to the "MDS/KION Hardware option – System Description/Installation Instructions" and to information regarding the Siemens INFINITY MEDSIDE DATA STATION.

Notes

Only personnel trained and authorized by Siemens shall be permitted to perform installation, service or maintenance of the KION / KION-i workstation.

Make sure to prepare the KION / KION-i workstation properly before disassembling and assembling. Refer to section "Hazard notices" in chapter "Important".

Any service or maintenance must be noted in a log book.

Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

After any installation, maintenance or service intervention in the KION / KION-i, perform a "Calibration" and a "Function check".
Refer to the "KION / KION-i anesthesia workstation – Operating Manual" for details.

4. Disassembling and assembling

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Handling PC boards ..... 4 - 2
Assembling guidelines ..... 4 - 2
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General

Disassembling and assembling of the main units in the KION / KION-i workstation is described in this chapter. If not stated otherwise, the assembling procedure is the reverse of the disassembling procedure.

The illustrations in the KION / KION-i Spare Parts List are very useful as a guide when disassembling and assembling the workstation.

Disassembling and assembling of the following units is described in the "KION / KION-i anesthesia workstation – Operating Manual", chapter "Routine cleaning":

- Patient cassette
- CO_2 Absorber
- Bag-in-bottle.

4

During clinical use of the KION / KION-i workstation, it is possible to rotate the user interface arm and the patient unit into a position suitable for the user. It is thus very important to check tubes and cables when assembling the KION / KION-i workstation. Make sure that no tubes nor cables are squeezed when rotating the user interface arm and the patient unit.

Preparations

Before disassembling or assembling the KION / KION-i workstation:

- Disconnect the gas supplies (wall and/or tank).
- Disconnect the mains power cable.
- Set the power switch on the control panel to **Off**.
- Make sure that all gas conveying parts are cleaned according to instructions in the "KION / KION-i anesthesia workstation – Operating Manual", chapter "Routine cleaning".

After any installation, maintenance or service intervention in the KION / KION-i, perform a "Calibration" and a "Function check".
Refer to the "KION / KION-i workstation – Operating Manual" for details.

Handling PC boards

The PC boards contain components that are highly sensitive to static electricity.

Those who come into contact with circuit boards containing sensitive components must take certain precautions to avoid damaging the components (ESD protection).

When working with ESD sensitive components, always use a grounded wrist band and grounded work surface. Adequate service tools must also be used.

PC boards (spare parts) must always be kept in protective packaging for sensitive electronic device.

PC boards must not be inserted or removed while the mains power or battery power is applied to the PC boards.

Remove and insert the PC boards very carefully to avoid damage to the connectors.

Assembling guidelines

All parts of the workstation assembled with screws and nuts are tightened with a specified torque. In order to maintain these specifications over time, it must be ensured that after any service intervention, removed parts are re-assembled and secured according to instructions. Make sure to follow the guidelines regarding tightening torque as stated below:

Thread size M3: 0.95 ±0.05 Nm

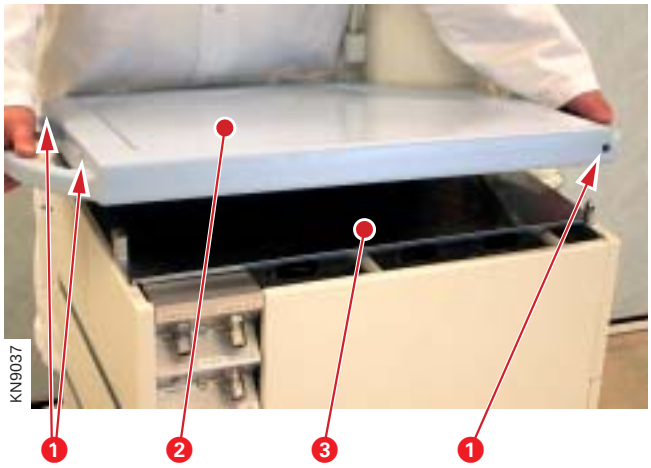
Thread size M4–M6: 3.1 ±0.1 Nm.

Internal tubing

KION workstations with S/N 00125 – 01405 are equipped with quick couplings for the internal tubing. A repeated disconnection/connection of such tubing may cause leakage.

Covers

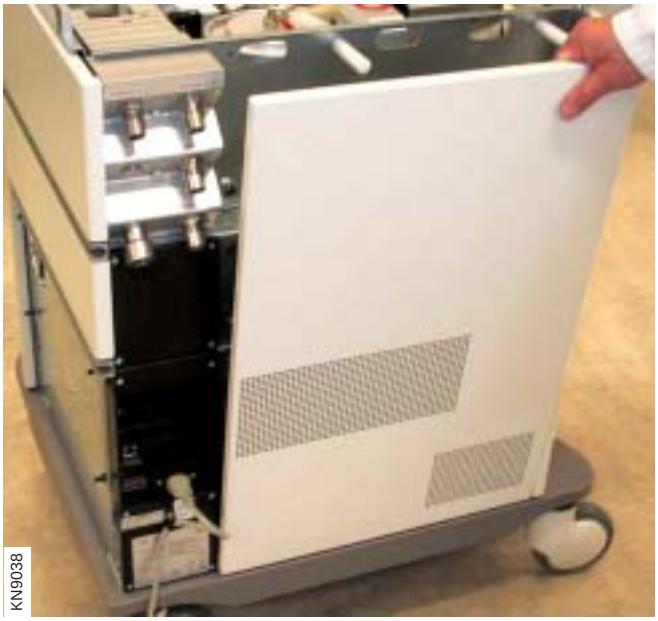
Top cover



- Remove the three screws (1) holding the top cover.
- Lift off the top cover (2).
- Lift off the shield cover (3).

Note: Handle the top cover carefully. The shelf may slide out if the top cover is tilted.

Trolley covers



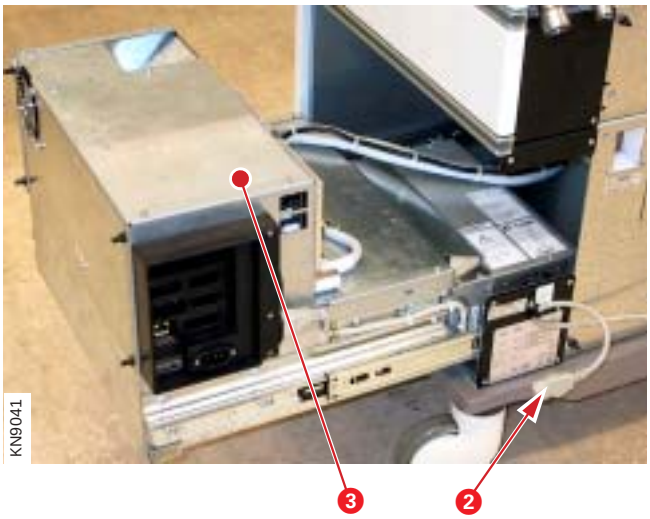
The trolley covers are of a snap-on type. No tools are needed to remove the trolley covers. The photos show some of the trolley covers.

- To remove the trolley covers, pull them straight out.
- To mount the trolley covers, place the cover in position and press it onto the studs.

4

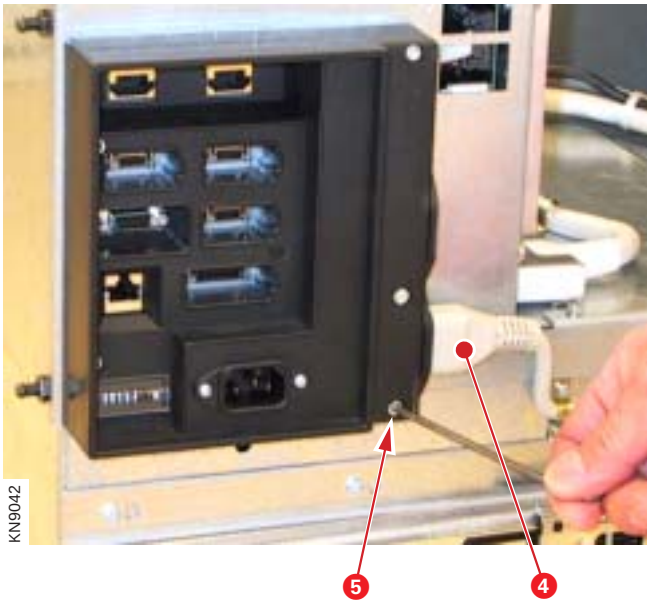
Battery drawer

- Remove the screws (1).

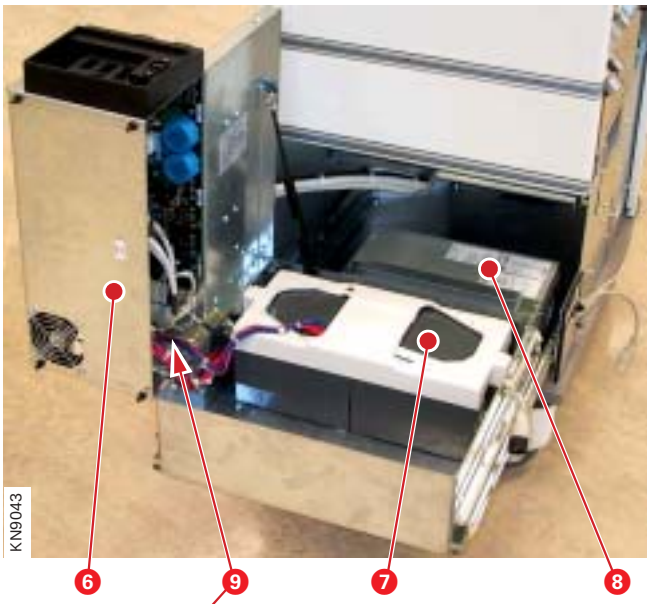


- Disconnect the mains power cable (2) from the inlet connector.
- Pull out the battery drawer (3).

Power & Communication interface



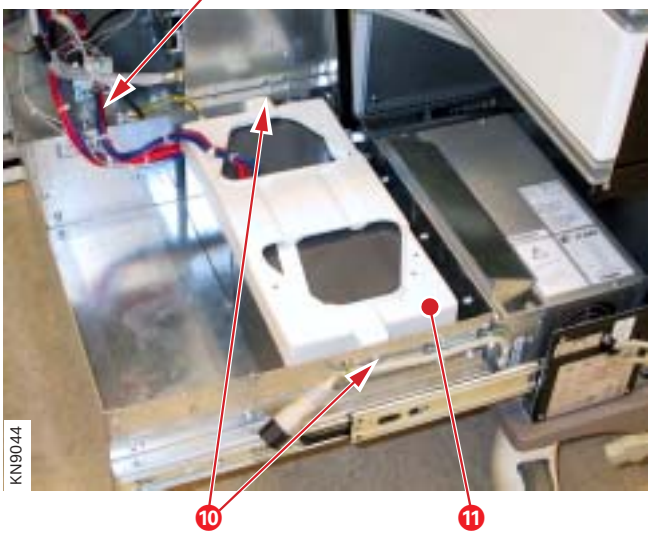
- Disconnect the AC/DC Converter cable (4).
- Disconnect the Isolation transformer cable if such is connected (optional).
- Remove the screw (5).



- Open the Power & Communication interface housing (6).

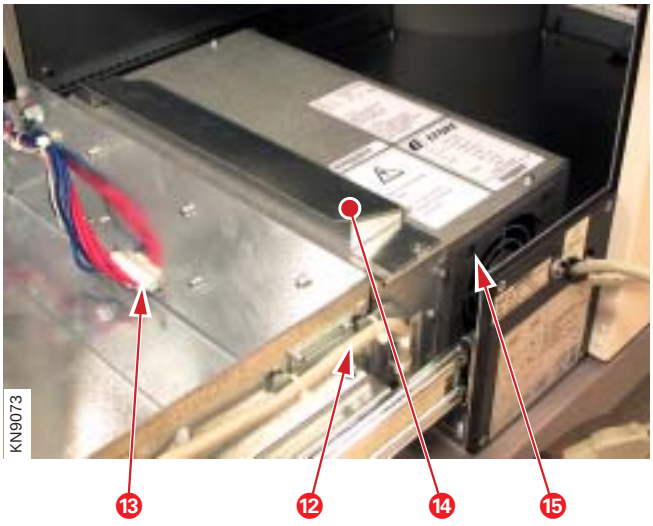
The Internal battery (7), the AC/DC Converter (8) and all PC boards inside the Power & Communication interface are now accessible.

> Always disconnect the battery cable (9), when working inside the Power & Communication interface.
>
> Keep fingers away when closing the Power & Communication interface and the Battery drawer!



To remove the internal battery:

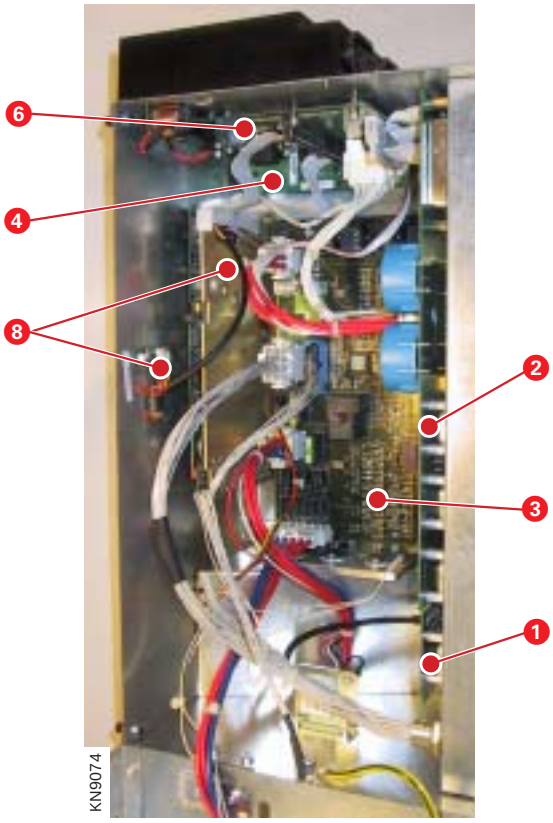
- Remove the two screws (10) securing the battery holder (11).
- Lift off the battery holder and the internal battery.



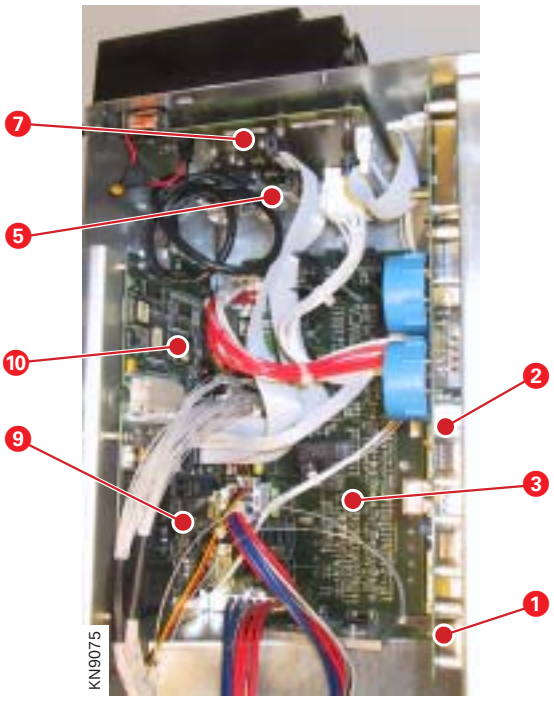
To remove the AC/DC Converter:

- Remove the internal battery.
- Remove the cable ties and cable clamp securing the AC/DC Converter cable (12) to the battery drawer.
- Carefully disconnect the Power cable and Signal cable connectors (13).
- Remove the seven screws holding the AC/DC Converter to the battery drawer
- Lift off the AC/DC Converter.

When assembling the unit, make sure that the guide plate (14) and the rubber seal (15) are mounted on the AC/DC Converter.



Unit with CPS Network PCB



Unit with IDS Network PCB

To remove the PC boards inside the Power & Communication interface:

- Disconnect cables from the concerned PC board.
- Carefully remove the screws/nuts holding the PC board and lift off the board.

The PC boards are:

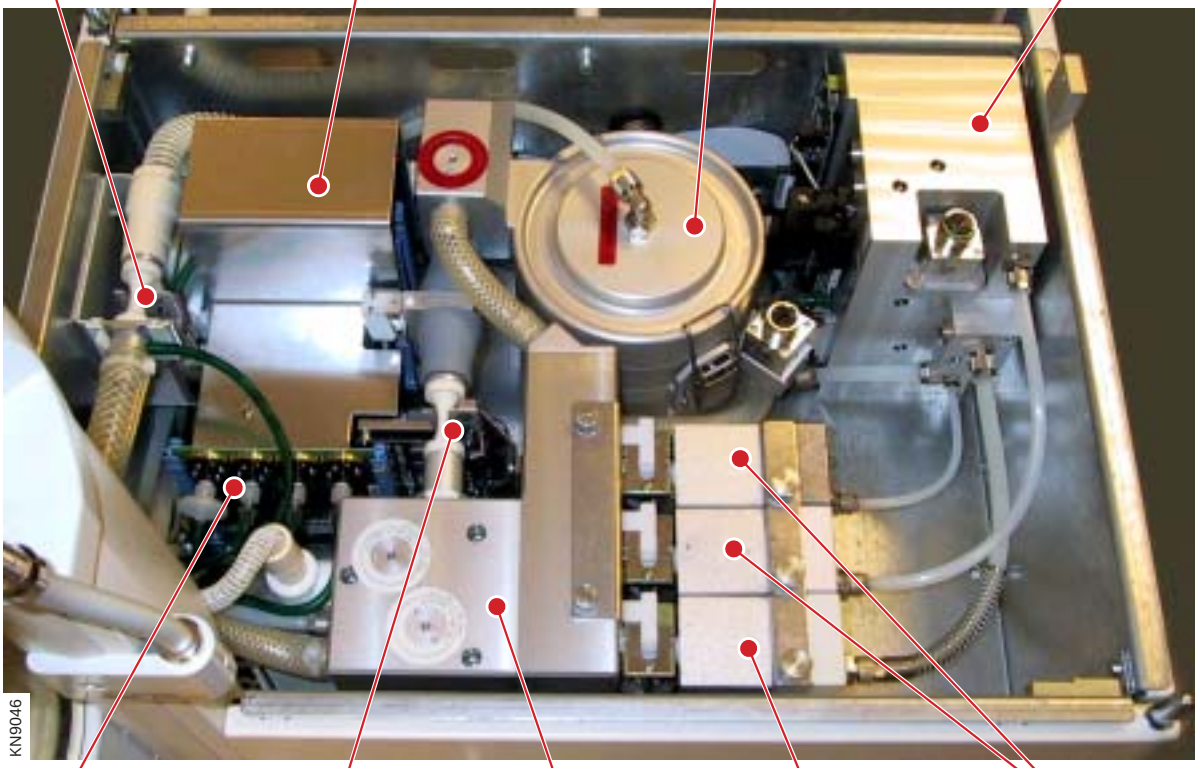
1. PC 1747 CAN/RS232 Interface
2. PC 1753 DC/DC Converter
3. PC 1675 Power Supply
4. PC 1761 MIB Connector for KION with S/N 03645 or lower, i.e. units equipped with CPS Network PCB.
5. PC 1843 MIB Connector 2 for KION / KION-i with S/N 03646 or higher, i.e. units equipped with IDS Network PCB.
6. PC 1754 Connector for KION with S/N 03645 or lower, i.e. units equipped with CPS Network PCB.
7. PC 1856 Connector for KION / KION-i with S/N 03646 or higher, i.e. units equipped with IDS Network PCB.
8. PC A101 CPS Network PCB including the small PC A301 Monitor Option and Setup Memory Board for KION with S/N 03645 or lower.
9. PC A110 IDS Network PCB for KION / KION-i with S/N 03646 or higher.
10. PC A120 CAN/MIB for KION / KION-i with S/N 03646 or higher.

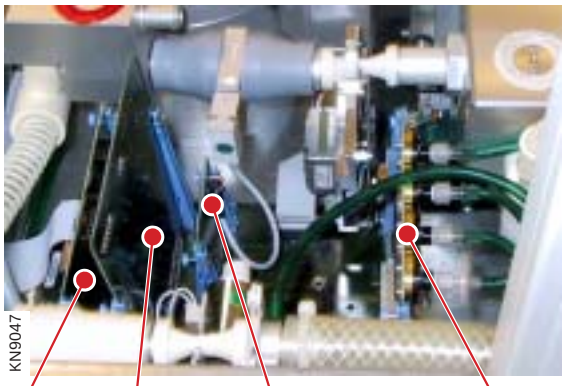
Pneumatic section

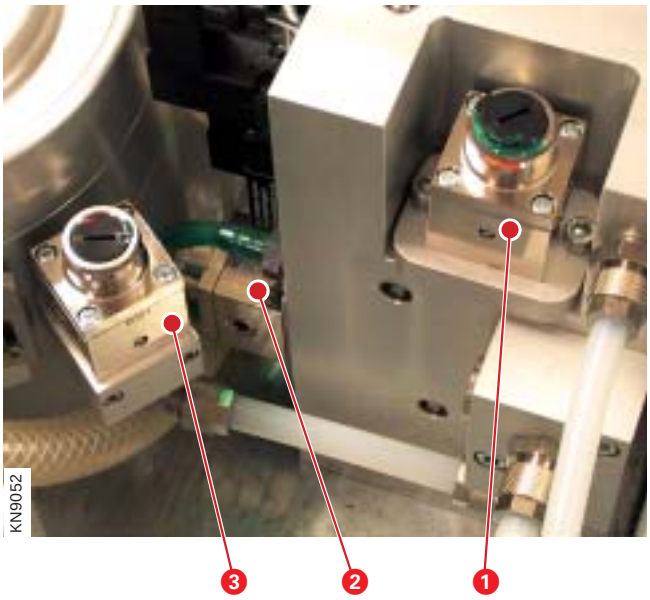
All parts inside the pneumatic section are accessible when the top cover and the shield cover is removed.

The KION / KION-i workstation in this illustration is equipped with a protective plate covering PC 1730 CONTROL, PC 1737 MEASURING and PC 1797 FRESH GAS FLOW.

This protective plate was introduced in KION workstations delivered as from July 1998. The protective plate must be removed to access the mentioned PC boards.





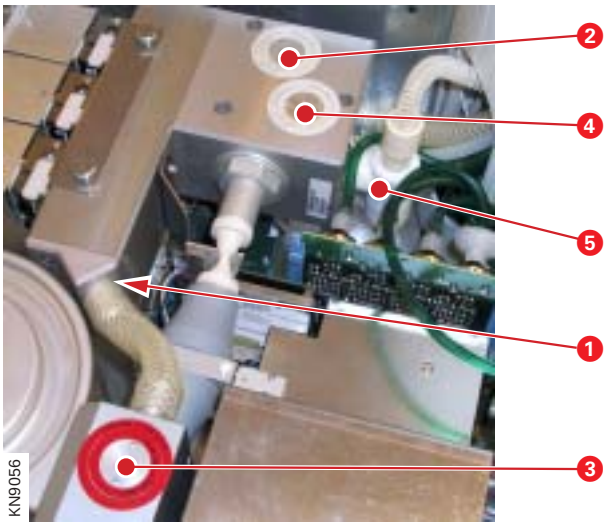


Pressure regulators

There are three pressure regulators inside the Pneumatic section:

1. REG 1 (20 kPa) controlling the pressure in the Mushroom valve control gas supply.
2. REG 2 (320 kPa) controlling the O_2 pressure to the Instant O_2 Supply-block.
3. REG 3 (100 kPa) controlling the pressure inside the Fresh gas pressure container.

The pressure regulators are keyed to avoid mixing.



Safety valves

There are five safety valves inside the Pneumatic section:

1. SV 1 (600 kPa) protecting the vaporizers.
2. SV 2 (14 kPa) located in the drive gas channel.
3. SV 3 (18 kPa) located at the Fresh gas pressure container and the Inspiratory fresh gas valve.
4. SV 4 (14 kPa) located in the fresh gas channel.
5. SV 8 (-3.5 kPa) protecting the pressure transducers from negative pressures.

SV 1

SV 8

To remove SV 1:

- Remove the fresh gas pressure container.
- Using a 3 mm insex bit, remove the screws holding the cover and lift off the cover.

To remove SV 2–4:

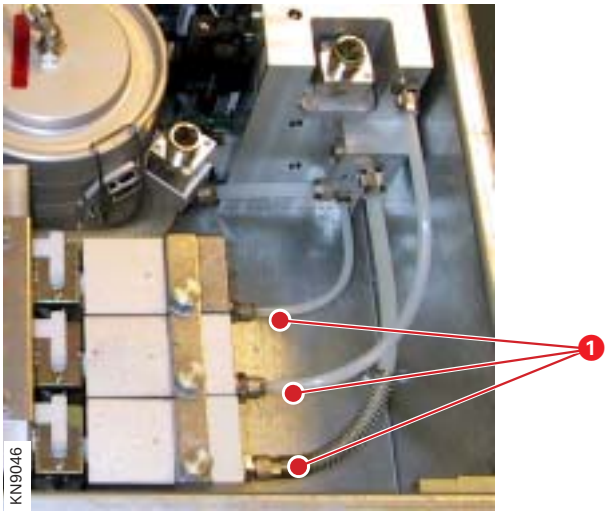
- Use the KION service tool "Wrench for safety valve" to unscrew the valve.

To remove SV 8:

- Pull off the complete valve housing from the nipple on the Inspiratory gas block

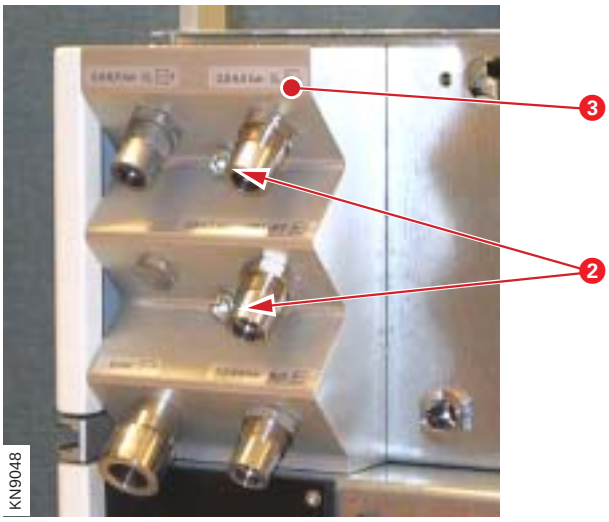
  Note: SV 8 must be mounted vertically as shown in the illustration. A deviation of ±10° is permissible.

Gas distribution block



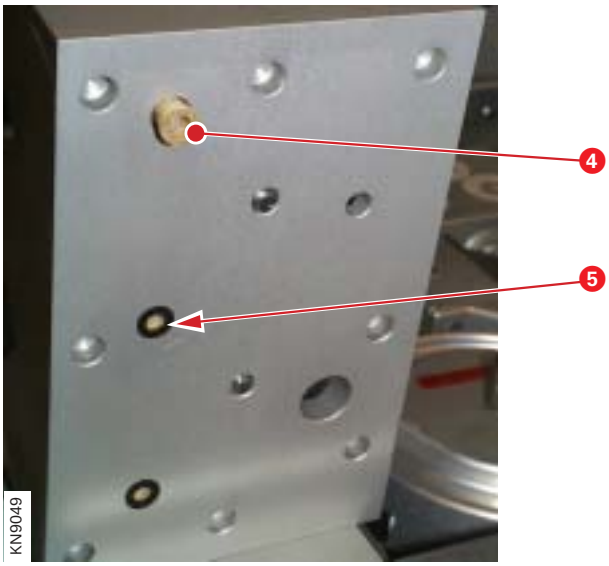
- Disconnect the three gas tubes (1) from the gas modules.

  Note: This disconnection will depressurize the gas distribution block which must be done before disassembling the block.



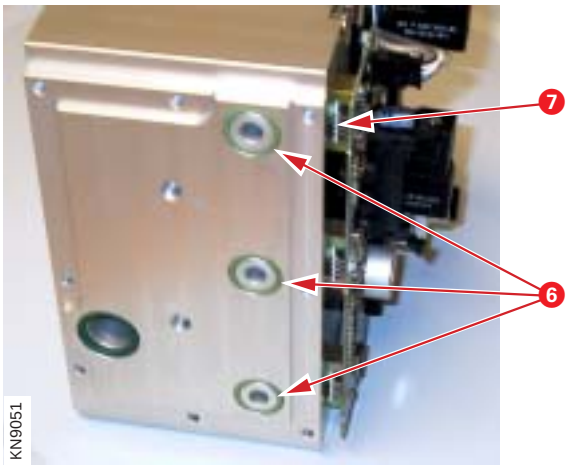
- Remove the two screws (2) and lift off the gas connection housing (3) from the gas distribution block.

> There may still be some gas pressure left in the gas channels inside the gas distribution block causing the valve housings (OV1–OV3) to "pop-out".



- The gas inlet filters (4) with gaskets (5) in the gas connection housing are now accessible.

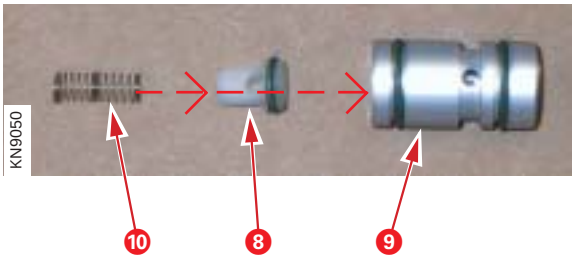
  Note: These gas inlet filters was not included at start of KION production and are thus not fitted in units with S/N below approx. 325.



There may still be some gas pressure left in the gas channels inside the gas distribution block causing the valve housings (6) to "pop-out".

When handling greased valve parts – always wear protective gloves.

- Carefully pull out the valve housings (6).
  Note: Be careful not to damage the O-rings in the gas distribution block.
- Note that there are gaskets (7) mounted between the gas distribution block and the pressure transducers on PC 1720 Wall pressure.

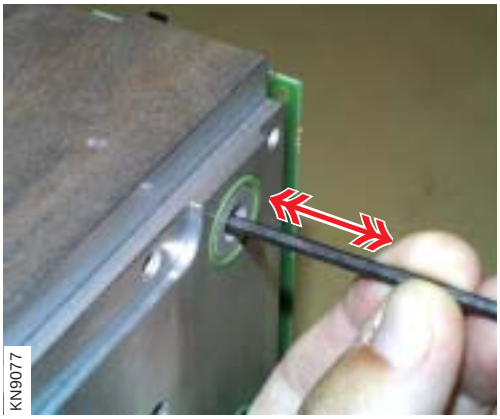


When assembling the one-way valves (OV1–OV3).

- Insert and carefully push the valve plunge (8) as far as it will go into the valve housing (9).
- Insert the valve spring (10) into the valve plunge.

  Note: This is the assembling position of the valve plunge. Once assembled, the plunge must be pushed back to its working position.

- Make sure that the valve spring is kept straight while carefully inserting the valve housing, including valve plunge and valve spring, into the gas distribution block.
- Push it in as far as it will go.

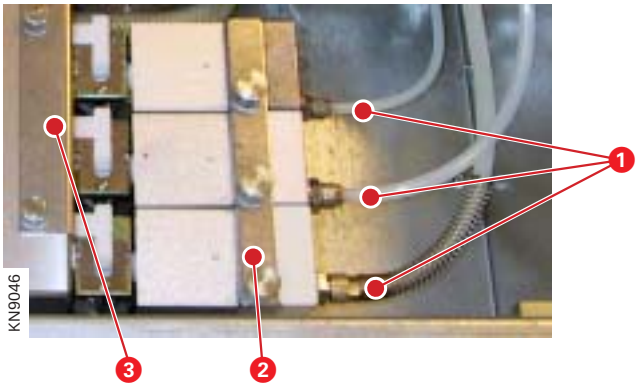


- In this position, insert a suitable hexagonal wrench through the valve housing and push back the plunge to its working position.
- Check that the valve plunge is moving freely inside the valve housing.

Inspiratory control

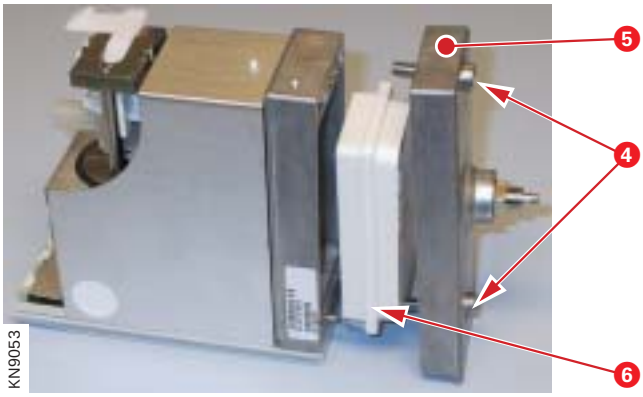
Gas modules

To remove the gas modules:



- Disconnect the three gas tubes (1) from the gas modules.
- Remove the locking rail (2).
- Loosen the two screws holding the springloaded plate (3) and pull out the gas modules.

To disassemble the gas modules:



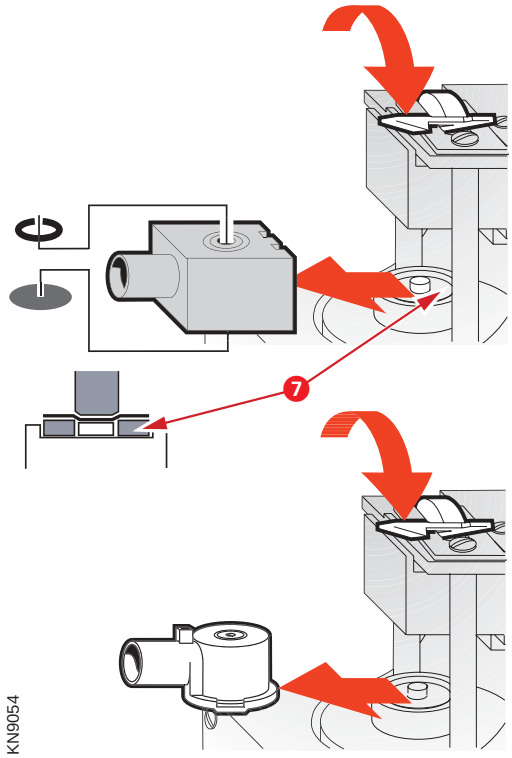
- Unscrew the two screws (4) and lift off the cover (5).

  Note: The rubber seal (6) must be mounted on the filter. When replacing filter, move the rubber seal from the old to the new filter.

Gas module Type I (with metal nozzle unit):

- Open the hatch and pull out the nozzle unit.

> Do not use any sharp tools that may damage the valve seat when replacing the O-ring and the diaphragm.

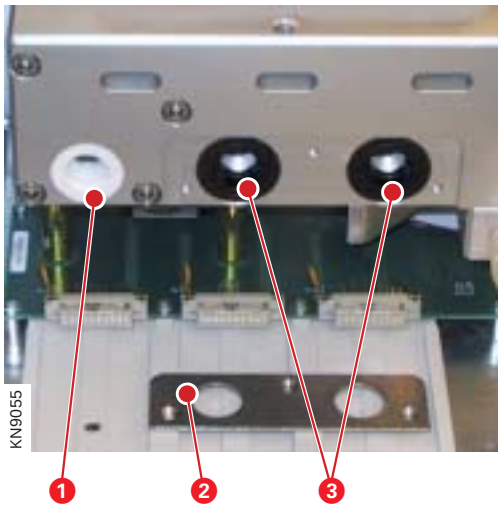


- On the two fresh gas modules (BP modules of Type I), make sure that the washer (7) is placed in position. This washer is not used in the drive gas module.

Gas module Type II (with plastic nozzle unit):

- Open the hatch and pull out the nozzle unit. The nozzle units are provided with a mechanical key to prevent that the nozzle unit is mounted into wrong gas module.

> After replacement of diaphragms or plastic nozzle units, wait 10 minutes before connecting pressure to the gas modules.

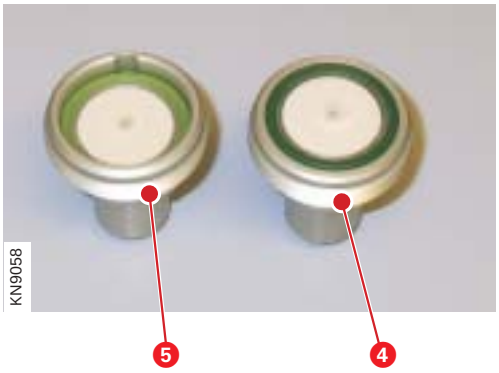


Inspiratory gas block

Seal for the drive gas module and cuffs for the fresh gas modules are mounted in the Inspiratory gas block. To remove the seal/cuffs:

- Remove the gas modules.
- The seal (1) for the drive gas module is now accessible.
- Remove the three screws holding the cover plate (2) and lift off the cover plate.
- The cuffs (3) for the fresh gas modules are now accessible.

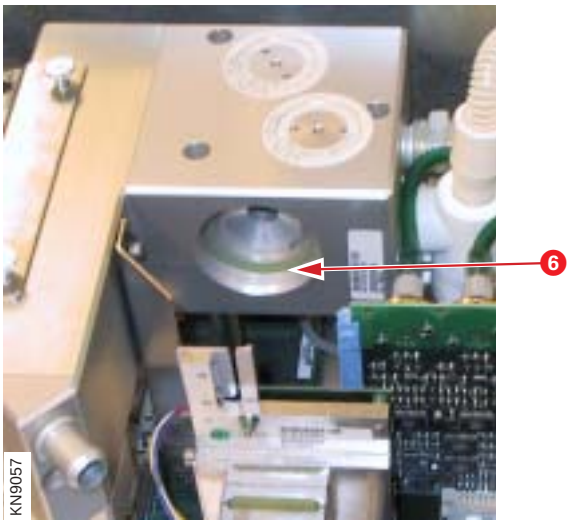
Note: Do not use a tool with sharp edges that may damage the inspiratory gas block when removing the seal/cuffs.

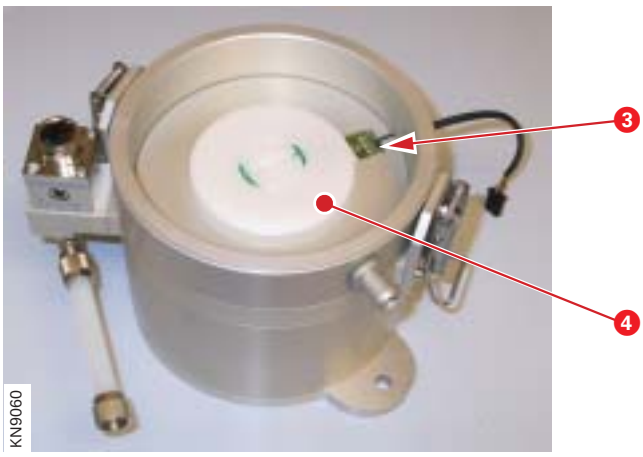


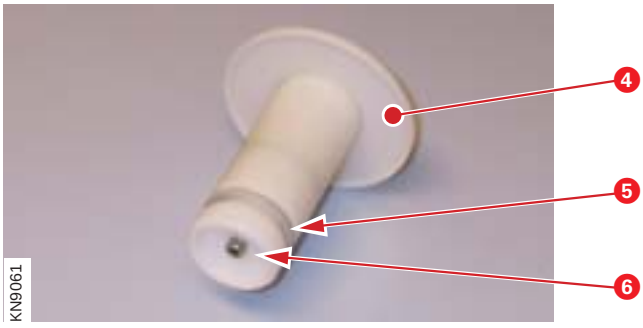
There are two versions of the one-way valve OV 4:

- Old version (4)
- New version (5).

Note: The O-ring (6) in the valve seat is used only in combination with OV 4 of the new version (5).







Fresh gas pressure container

To remove the fresh gas pressure container:

- Disconnect all tubings from the fresh gas pressure container.
- Disconnect the position sensor cable.
- Remove the two screws at the base plate.

If the fresh gas pressure container is to be disassembled, note the following:

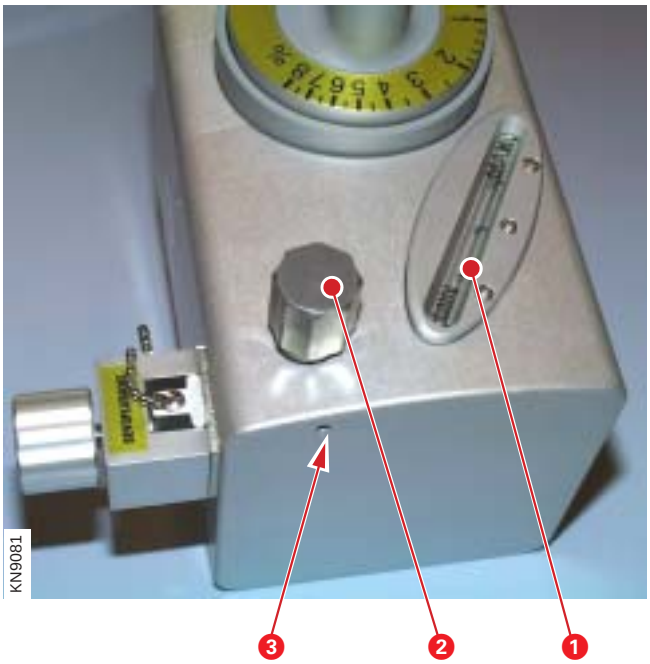
- Before disassembling the fresh gas pressure container, mark (1) with a pen the relative positions between the containers:
  - – Top cover
  - – Intermediate parts
  - – Base plate.

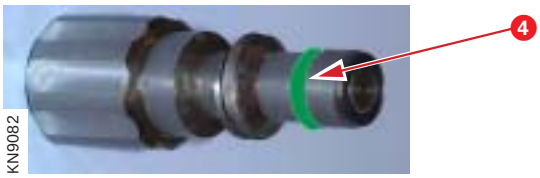
  This marking will make a correct assembling easier.
- When assembling the fresh gas pressure container, make sure that the diaphragm (2) and the big O-rings between the intermediate parts and the base plate are correctly seated.

The following parts are now accessible inside the fresh gas pressure container:

- Diaphragm (2)
- PC 1752 Position sensor (3)
- Piston (4)
- Piston seal (5). Remove the screw (6) and the lower part of the piston when replacing the piston seal.

Note: The piston and PC 1752 are matched and delivered as a spare part kit. They must be replaced at the same time.





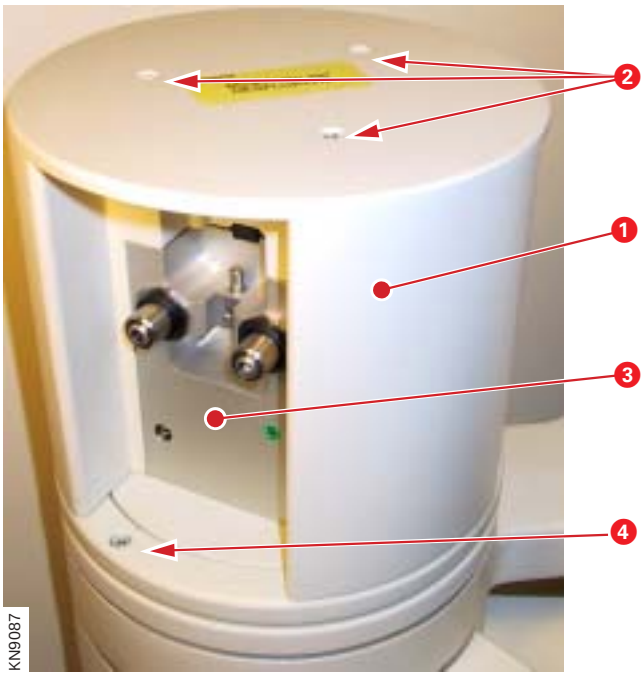
PIVap vaporizers

The PIVap vaporizers must not be disassembled further than shown below and in the KION Spare Parts List.

Before disassembling, empty the vaporizer.

- When replacing the window (1), make sure to use correct window and window frame. Refer to Service Instructions EM010/02/I.
- To remove the vaporizer valve (2), remove the screw (3) and carefully pull out the valve.
  Note: The screw is sealed with Loctite.
- When mounting the vaporizer valve (2):
  - Apply Loctite® 243 on the screw (3).
  - Do not tighten the screw (3) to hard, the knob must be easy to turn.

- When replacing the O-ring (4), apply a thin layer of special grease on the new O-ring.



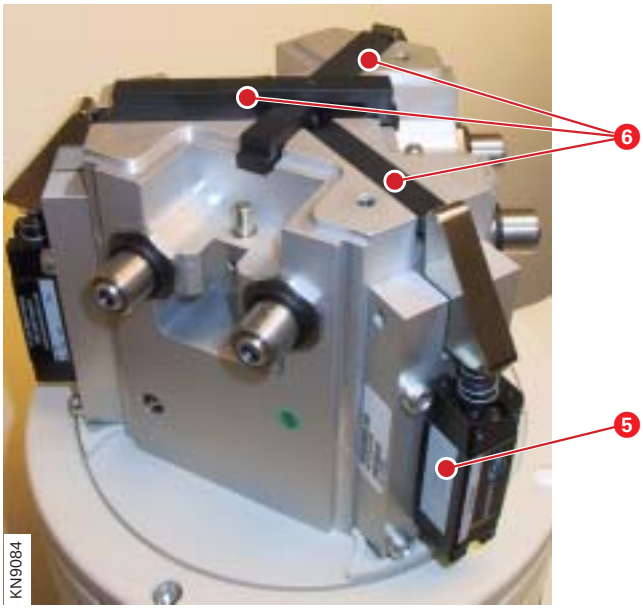
Vaporizer magazine

To remove the magazine cover (1):

- Remove the three screws (2).
- Carefully lift off the magazine cover (1).

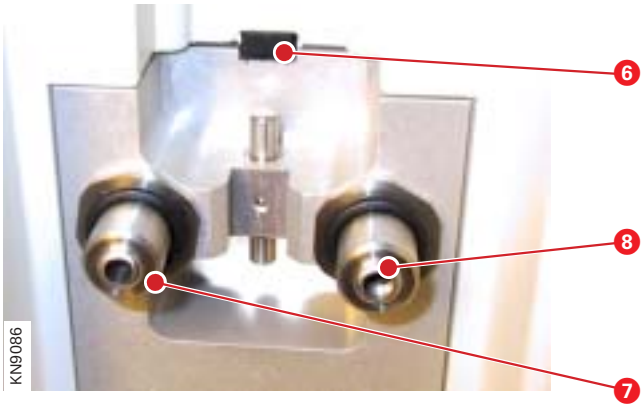
To remove the complete vaporizer magazine (3) including magazine cover (the magazine cover can remain mounted on the magazine):

- Remove the four screws (4).
- Carefully lift off the vaporizer magazine (3).



With the magazine cover removed, the vaporizer selections valves 1–3 (5) and the slide bars (6) are accessible

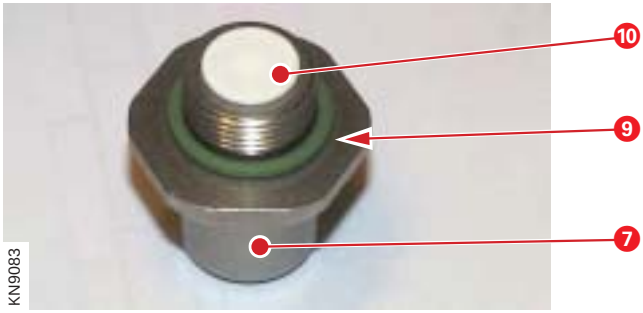
Note: The slide bars (6) are teflon coated and must be handled carefully.



When mounting the magazine cover (1):

- Make sure that the slide bars (6) fit into the corresponding slots inside the magazine cover.
- When the magazine cover is placed in position on the vaporizer magazine, the three slide bars (6) must be pushed in a few mm to snap into position. If not in position, the cover will ride on the slide bars and the cover cannot be correctly mounted.

The O-rings on the magazine inlet connector (7) and the magazine outlet connector (8) are accessible without any disassembling of the vaporizer magazine.



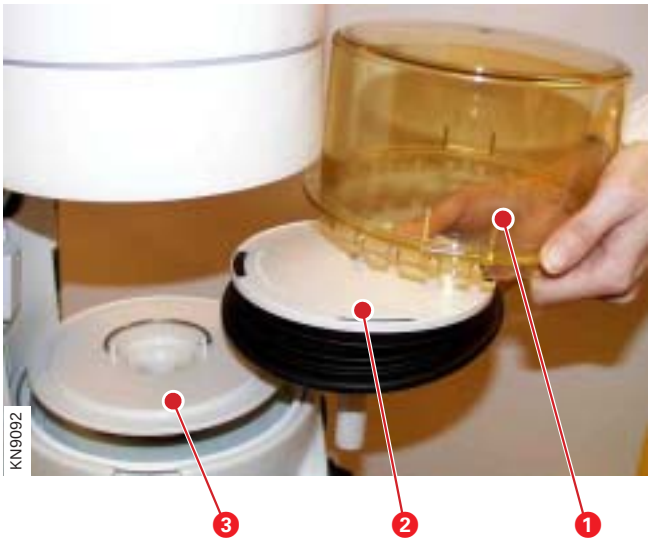
Each of the three magazine inlet connectors (7) are equipped with an O-ring (9) and a one-way valve OV9–11 (10). Remove the connector to make the O-ring and the one-way valve accessible.

With the vaporizer magazine removed, the small O-ring (11) and the large O-ring (12) on the vaporizer magazine hub are accessible.

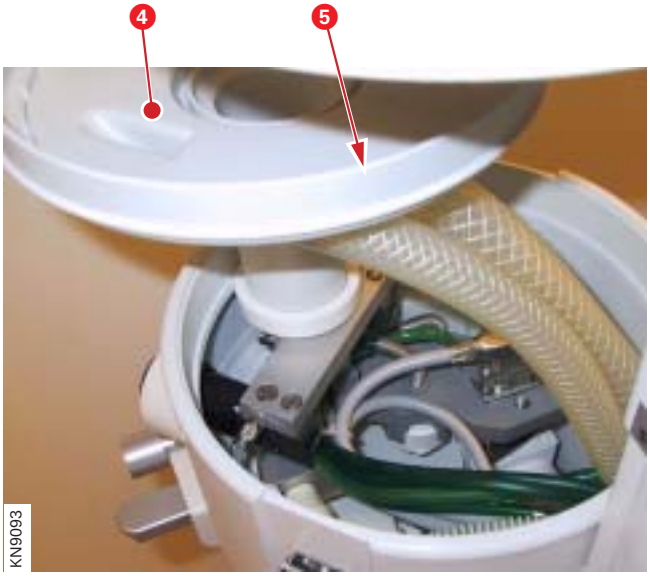
When assembling the vaporizer magazine:

- Apply a thin layer of special grease on the O-rings.
- Place the vaporizer magazine very carefully in position onto the magazine hub.

Patient unit

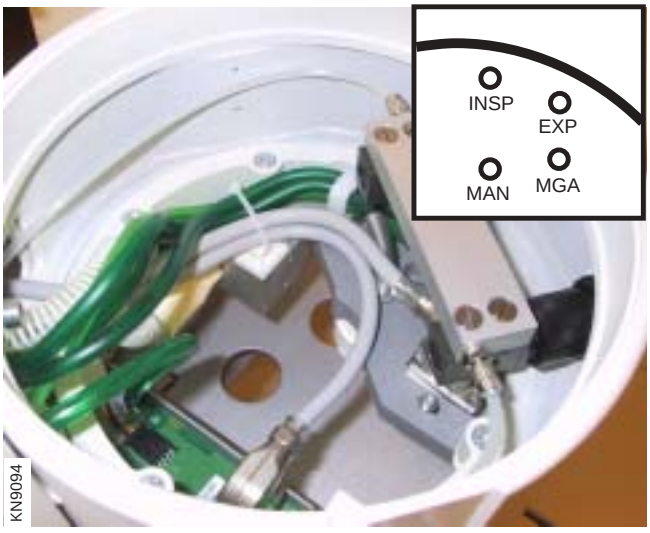


- Unclip and lift off the bellows housing (1).
- Lift off the breathing bellows (2).
- Lift off the bellows support plate (3).



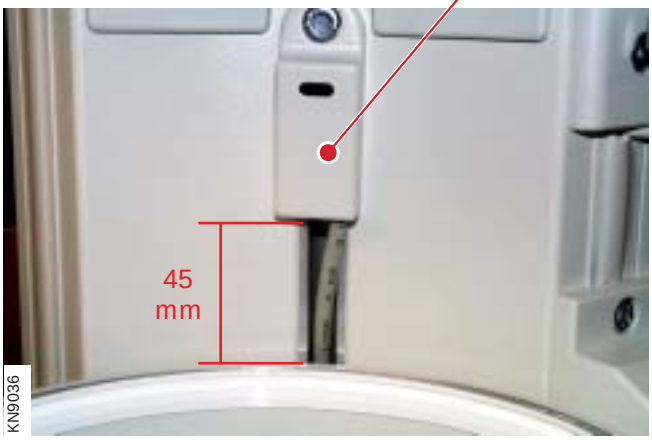
- Remove the bellows base plate (4) including its bellows housing seal (5) and the two connected hoses.
  Note: The two connected hosed (for drive gas and for exhaust gas) must be disconnected inside the pneumatic section.

The parts inside the patient unit are now accessible.



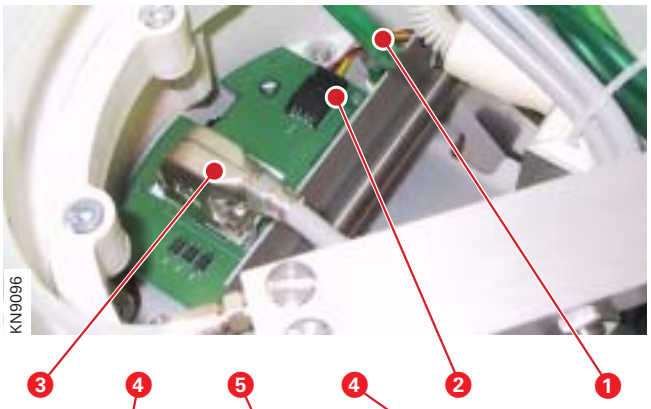
- This illustration shows the position of the tubes and cables inside the patient unit. As it is possible to rotate the breathing system, it is thus very important to check tubes and cables when assembling the patient unit. Make sure that no tubes nor cables are squeezed when rotating the breathing system.
- The detail drawing shows the position of the tube nipples for the pressure transducer and multigas analyzer tubes.

- When mounting the bellows base plate, make sure that the bellows housing seal (5) on the bellows base plate is correctly mounted, see illustration.

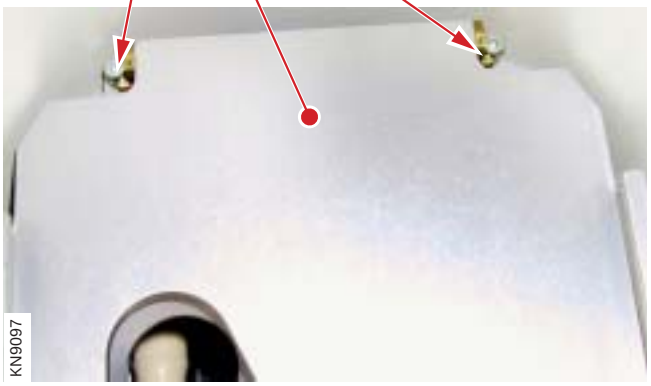


- When mounting the bellows position sensor (6), make sure that the sensor is adjusted into correct position (level) as shown in the illustration.

Support plate for patient cassette



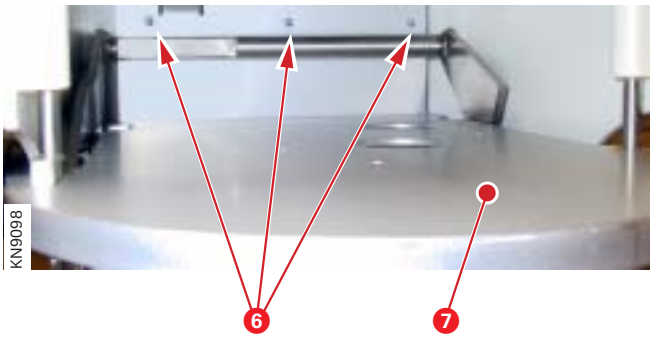
- Remove the bellows base plate as described above.
- Disconnect the mushroom valve control gas supply tube (1). If necessary, cut the tube.
- Disconnect N77 (2) and N78 (3) from PC 1755 PATIENT CASSETTE VALVE CONTROL.



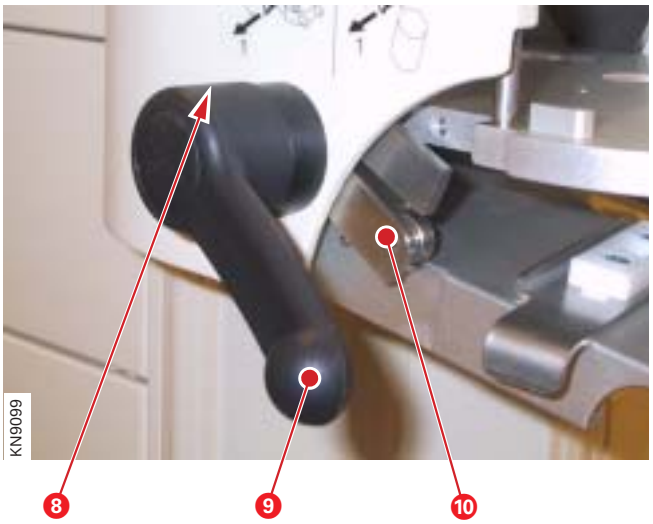
- From underneath the patient unit, remove the screws (4) and lift off the absorber support plate (5) for the CO_2 Absorber.
  Note: Hold the absorber support plate when removing the screws. The absorber support plate will fall down when the screws are removed.

When mounting the absorber support plate:

- Apply special grease on the hinges.
- Secure the screws (4) with Loctite 243.

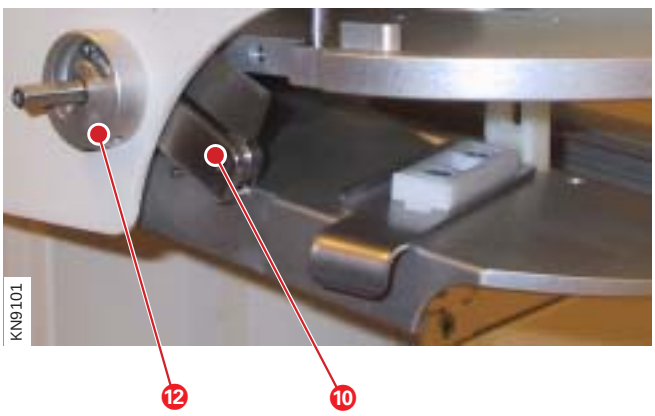


- Remove the screws (6) and lift off the cover plate (7) from the docking station.



- Loosen the screw (8) and remove the locking handle (9).
- Pull out and lift off the lifter (10).

- Carefully pull down the support plate for patient cassette (11) and remove it from the patient unit.

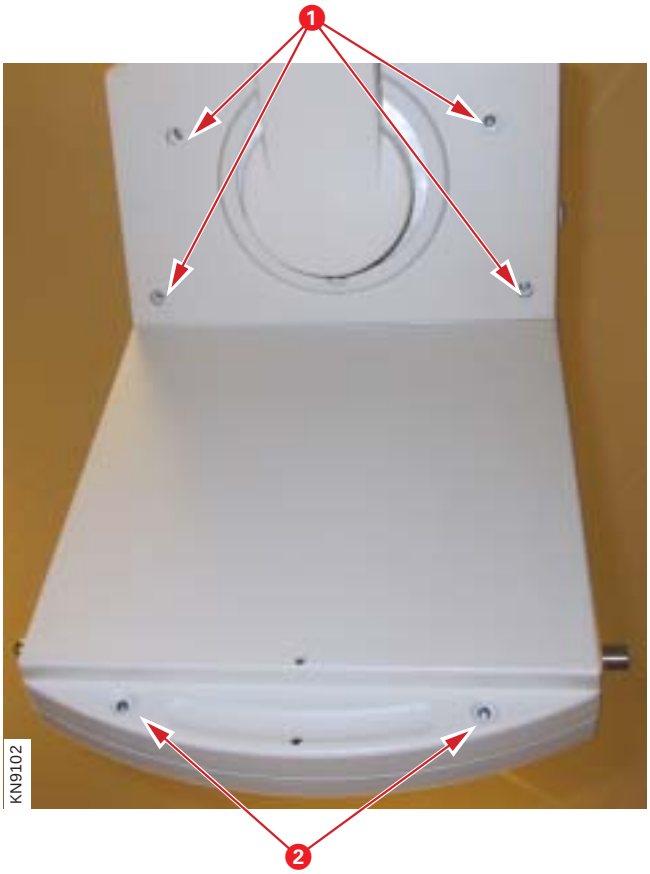


The excenter (12) is intended for adjustment of the patient cassette support plate position:

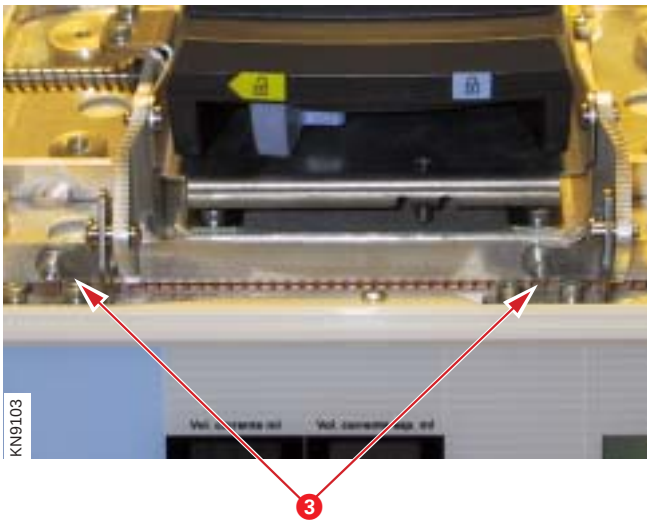
- For adjustment, refer to instructions for the "Support plate adjustment tool".
- For replacement of the complete locking device, excenter (12) and lifter (10), refer to instructions for the "Cassette locking device repair kit".

The assembling procedure for the patient unit is the reverse of the disassembling procedure previously performed.

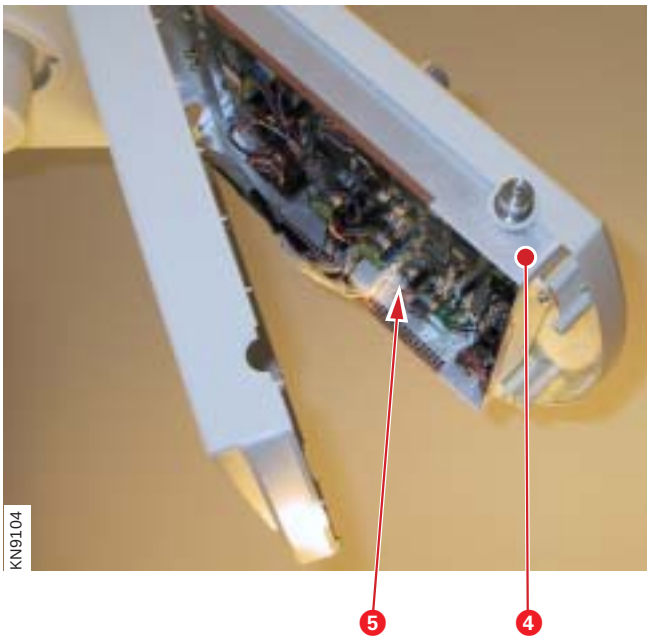
Control panel



- Remove the KION Monitor from the docking station.
- Remove the four screws (1) and lift off the upper cover.
- Remove the two screws (2) on the rear of the control panel.



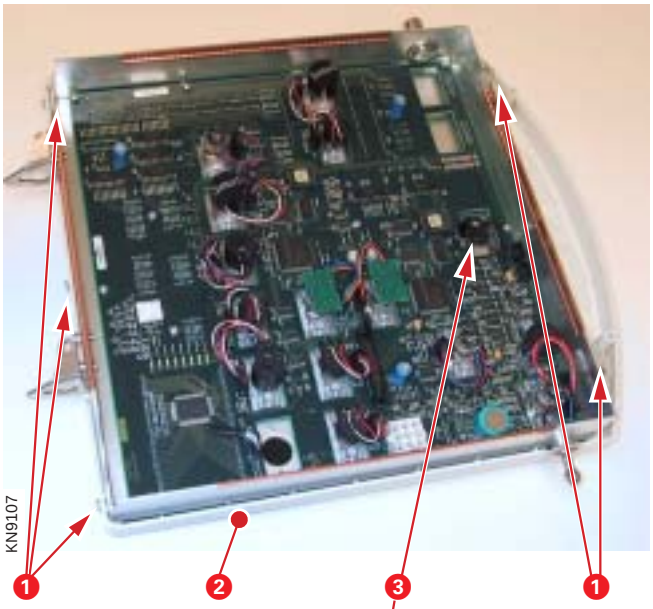
- Remove the two screws (3).



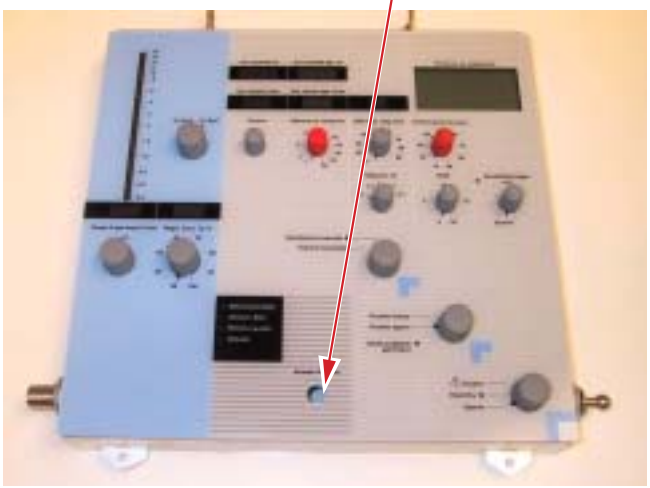
- Open the control panel housing (4).
- Disconnect the two panel cable connectors (5) from P9 and P17 on the PC 1672 CONTROL PANEL.
- Lift off the control panel housing (4).

When assembling the control panel housing, make sure that there are no pinched cables. Defective cables may short-circuit power supply, CAN-bus signals, etc.

Front panel

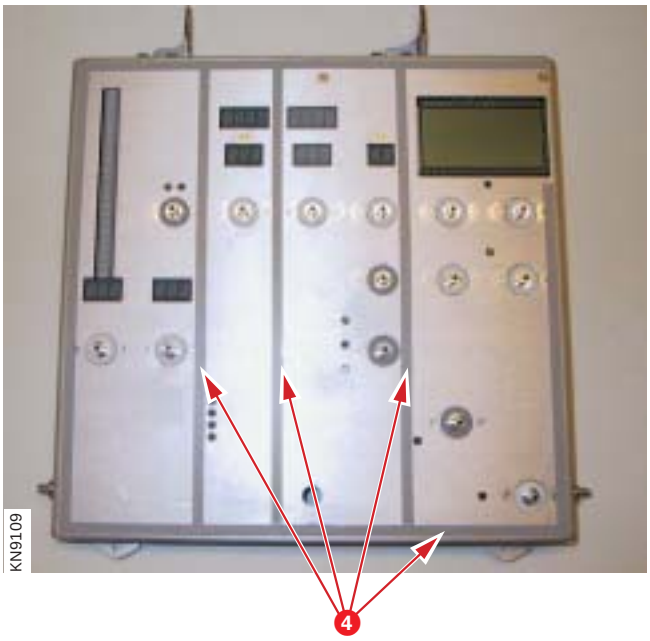


- Remove the control panel housing as described above.
- Remove the five screws (1) and lift off the front cover (2).

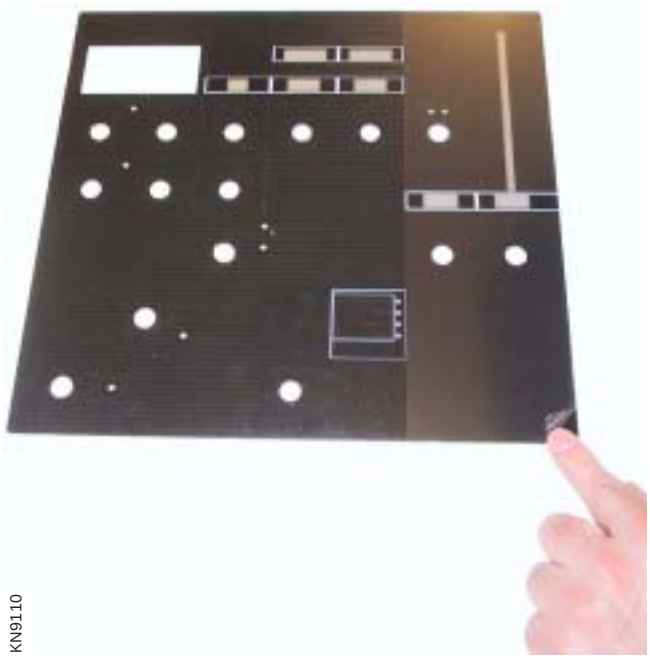


- Disconnect and remove the alarm silence push button (3).
- Remove all knobs from the potentiometers and switches.
- The front panel is mounted to the control panel housing with adhesive strips. Carefully remove the front cover from the housing.

When mounting the front panel to the control panel housing:

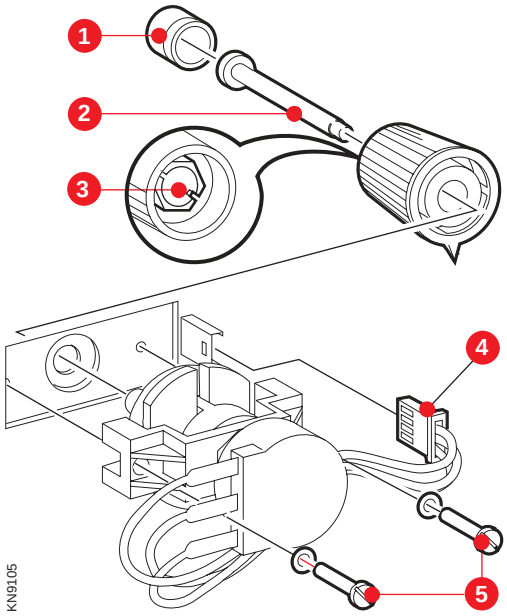


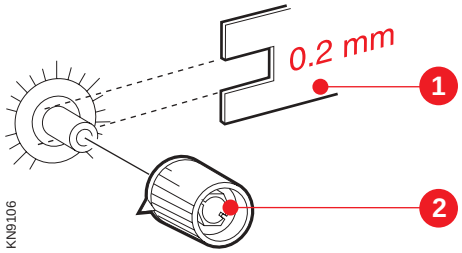
- Check that the adhesive strips (4) are properly attached to the control panel housing and that no parts of the strips are missing.



- Remove the protective foil from the rear side of the front panel.

- Mount the front panel on the control panel housing. Check that the LEDs on PC 1672 align with the corresponding holes in the front panel.





Front panel controls

- Remove the control panel housing as previously described.
- Remove the knob cover (1).
- Remove the pin (2) if the control has a push-button release function.
- Loosen the nut (3) holding the knob and lift off the knob from the control shaft. Use the knob holder tool (Order No. 62 04 197 E380E) when removing and mounting the control knobs.
- Disconnect the connector (4).
- Remove the two screws (5) and lift off the control.

The assembling procedure is the reverse of the disassembling procedure previously performed. The following points must be noted during assembling:

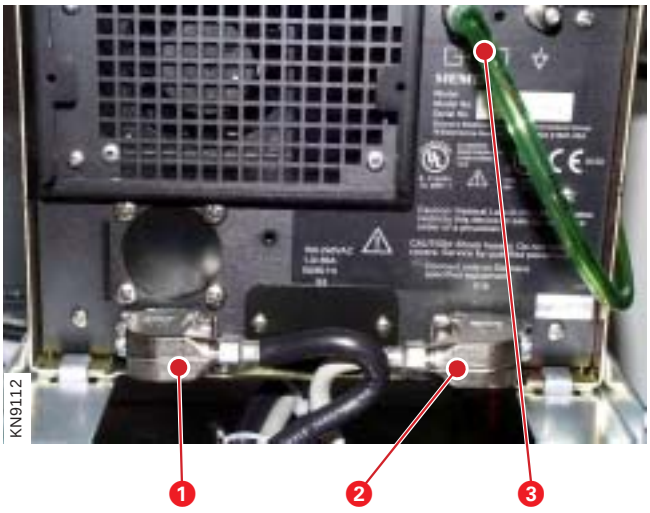
- If the control knob has a pointer, make sure that:
  - On the control panel switches; this knob pointer aligns with the indication lines on the panel in the different switch settings.
  - On the control panel potentiometers; this knob pointer aligns with the end position indications on the panel and, if applicable, with the values showed on the corresponding display.
- Tighten the nut (3) with a torque of approx.:
  - 150 Ncm on the big knobs
  - 90 Ncm on the small knobs.
- If the knob is hard to turn, it can be necessary to put a 0.2 mm thickness gauge (1) between the control panel and the knob while mounting the knob (2).

Multigas analyzer

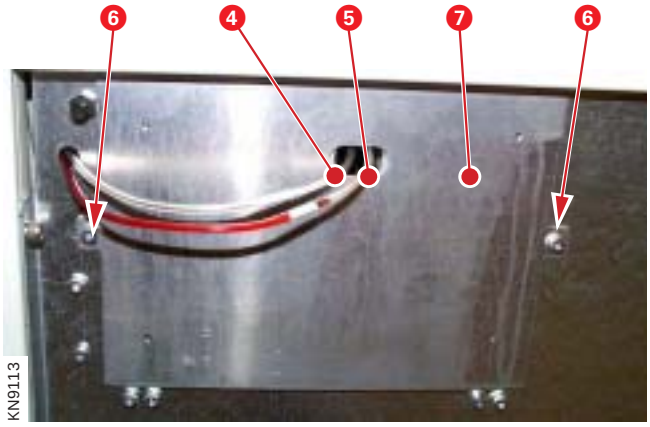
KION MultiGas 2000

For technical information on the KION MultiGas 2000, including disassembling and assembling instructions, refer to the KION MultiGas 2000 – Service Manual.

KION MultiGas+



- Disconnect the:
  - – Power cable (1).
  - – Communication cable (2).
  - – Sampling outlet tube (3).



- Disconnect the sampling inlet tubes (4 and 5). Note that the sampling tubes and the corresponding tube nipples are color marked for correct assembling
- Remove the screws (6) and lift off the cover plate (7).

- Pull out the multigas analyzer (8).

The assembling procedure is the reverse of the disassembling procedure described above.

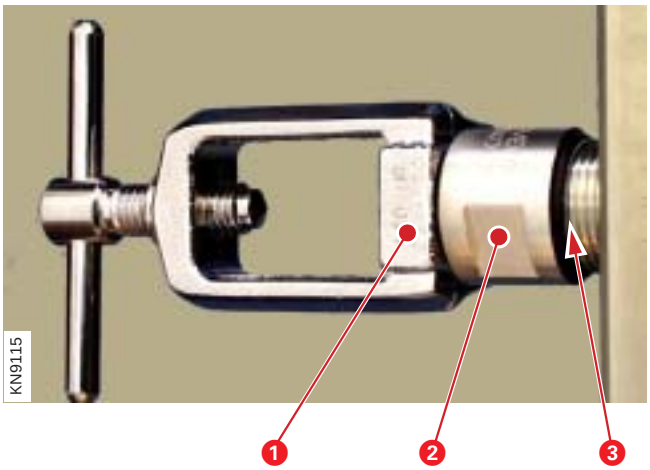
Backup gas supply manifold

Ensure that all gas supplies are shut off and all gas channels are depressurized before any service is performed on the backup gas supply manifold.

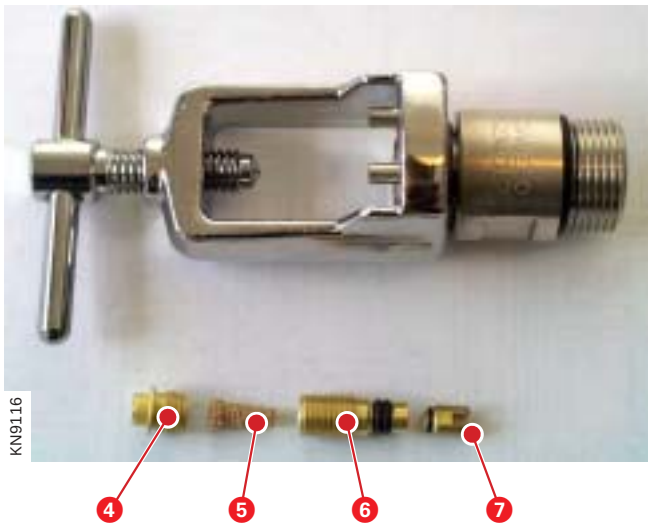
Explosion hazard! The very high pressure O_2-gas connected to the manifold require the use of special O_2-resistant grease, which can be supplied from your local Siemens representative. No other grease must be used!

When assembling the different parts of the manifold, always use new O-rings and gaskets. Apply a thin layer of special grease on the O-rings and gaskets.

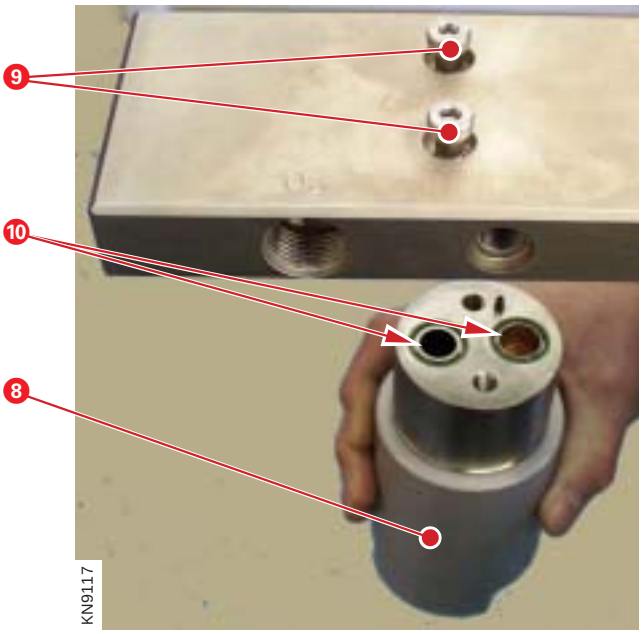
When performing service on the backup gas supply manifold, it is recommended that examination gloves are worn in order to keep all parts clean.



- To remove the yoke (1), unscrew the sleeve (2) using a 22 mm open-end spanner.
- When mounting the yoke, always use a new O-ring (3). Apply a thin layer of special grease on the O-ring. Tightening torque is approx. 50 Nm.

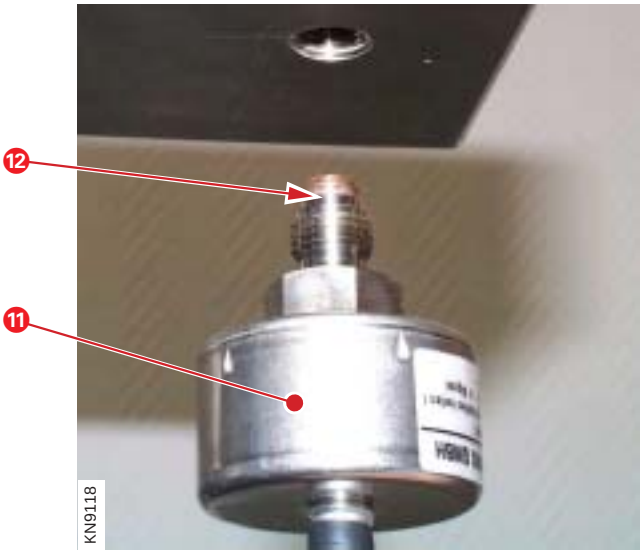


- The gas inlet channel inside the yoke contains the following parts:
  - Filter holder (4). To remove the filter holder, use a 5/32" (4 mm) hexagonal wrench.
  - Filter (5).
  - Valve seat (6) for the one-way valve. To remove the valve seat, use a 3/32" hexagonal wrench.
  - One-way valve OV5–OV8 (7).



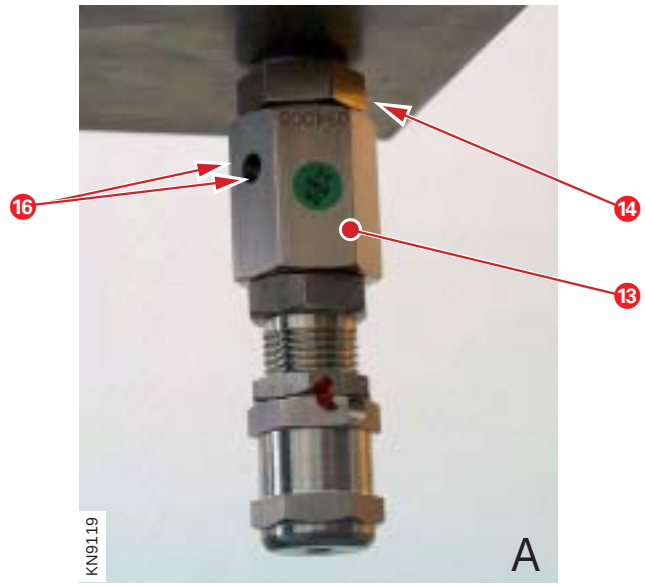
- To remove the pressure regulator REG5–REG7 (8), unscrew the two screws (9) using a 5 mm hexagonal wrench.

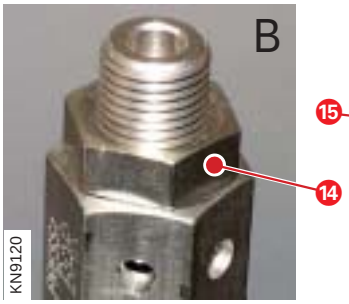
- When mounting the pressure regulator, always use new O-rings (10). Apply a thin layer of special grease on the O-rings. Tightening torque for the screws (9) is approx. 18 Nm.

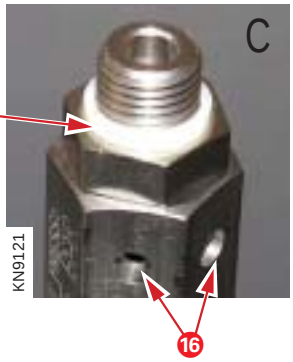


- To remove the pressure transducer (11), unscrew the transducer using a 19 mm open-end spanner.

- When mounting the pressure transducer, always use a new gasket (12). Apply a thin layer of special grease on the gasket.
- Tighten the pressure transducer by hand. Tighten further approx. half a turn using the open-end spanner.







- To remove the safety valve SV5–SV7 (13), loosen the nut (14) using a 19 mm open-end spanner and unscrew the safety valve.

- When mounting the safety valve:
  - Screw the nut (14 in Fig. B) as much as possible onto the safety valve. Note: There is a groove for the gasket in the nut. This groove must be facing upwards as showed in Fig. B.
  - Place a new gasket (15 in Fig. C) in this groove.
  - Screw the valve (13) as much as possible into the manifold.
  - Unscrew the valve until the two outlet holes (16) are facing away from the operator (downwards/ inwards).
  - *Hold the valve in this position and secure it by tightening the nut (14). Tightening torque for the nut is approx. 35 Nm.*

Only personnel trained and authorized by Siemens shall be permitted to perform installation, service or maintenance of the KION / KION-i workstation.

Make sure to prepare the KION / KION-i workstation properly before disassembling and assembling. Refer to section "Hazard notices" in chapter "Important".

Any service or maintenance must be noted in a log book.

Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

After any installation, maintenance or service intervention in the KION / KION-i, perform a "Calibration" and a "Function check".
Refer to the "KION / KION-i anesthesia workstation – Operating Manual" for details.

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Pre-use check

The KION / KION-i workstation demands the user to start the semi-automatic Pre-use Check (PuC) at every start-up of the workstation. It is also possible to access the PuC via the KION Monitor. The KION Monitor path to select PuC is:

Menu / Monitor Setup / Biomed / Service / Calibration / KION Pre-use Check

or

Menu / KION / Preuse (not applicable for SC 9000).

Note that Service Password is required to access the Service menu.

The Operating Manual describes how to perform this PuC. The description below gives a more detailed information about the PuC. This information can be used e.g. during troubleshooting of the KION / KION-i workstation.

Initialization

1. PuC instructions are shown on the KION Monitor.
2. CON sets the gas mixture to O_2/Air.

Check of control panel settings and of gas supply

1. The system checks that the Upper Press. Limit (UPL) knob is set between 60 and 80 cmH2O. Diagnostic (279) will be shown in the Diagnostic Log if UPL is not set correctly.
2. The system sets a flow of 0.5 l/min during 1.5 seconds to be generated by the gas modules AIR (N_2O) – BP and DRIVE GAS for self-adjustment of the flow in these gas modules.
3. The gas module AIR (N_2O) - BP generates a flow of 30 l/min.
4. The system checks that the AIR supply pressure is above 2.2 bar during 2.5 s.
5. If AIR supply pressure is above 2.2 bar during 2.5 s then AIR will be used as the selected gas for the PuC.
6. The system sets a flow of 0.5 l/min during 1.5 s to be generated by the gas module O_2 – BP for self-adjustment of the flow in this gas module.
7. If the AIR supply pressure drops below 2.2 bar during the 2.5 s, the gas module O_2 – BP generates a flow of 30 l/min.
8. If O_2 is used, the system checks that the O_2 supply pressure is above 2.2 bar during 2.5 s.
9. If O_2 supply pressure is above 2.2 bar during 2.5 s then O2 will be used as the selected gas for the PuC.
10. Diagnostic (260) will be shown in the Diagnostic Log if supply gas is missing.

If the UPL knob is not set correctly or if both AIR supply and O_2 supply Fails, the PuC will not start and the PuC start-up screen will remain on the KION Monitor. Simultaneously, a caution sound is activated.

Leakage automatic ventilation

Checking the patient unit

The description below refers to Figs. 1–3. The numbering in the description below (1–12) refers to Fig. 2.

The system is set for Manual Ventilation and Rebreathing. The PEEP valve is opened to depressurize system.

1. The system generates 5 ”flow puffs”, with a duration of 300 ms and 300 ms between them, to zero the flow transducers in the gas modules.
2. The system generates 5 ”pressure puffs” (40 cmH2O), with a duration of 2 s and 300 ms between them, to stabilize the system and to assure proper function of the seals. The PEEP valve is closed and opened between each ”pressure puff”.

3a. The system is emptied until the INSP pressure decreases to 1,5 cmH2O.
If the timeout (10 s) to empty system has elapsed, then a technical error code 9906 will be displayed and the check will Fail.
Diagnostic 261, subdata ...26 B2.

3b. The system is pressurized using a fresh gas flow of 20 l/min.

4. Calculates the filling volume by measuring the time to reach the 40 cmH2O.
5. Calculates the system volume based on the filling volume and the reached pressure (40 cmH2O).
6. The fresh gas flow is cut-off when INSP pressure has reached the initial pressure. The first initial pressure is 41 cmH2O.
If the timeout (15 s) to reach initial pressure has elapsed, then the Fresh gas digit display shows the reached pressure, a technical error code 9902 will be displayed and the check will Fail.
Diagnostic 261, subdata ...26 AE.
7. Waits to stabilize the pressure (first stabilization period is 10 s).

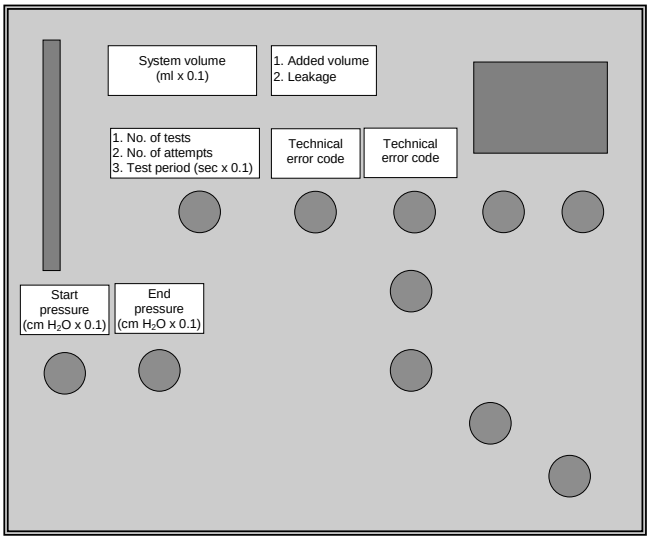


Fig. 1 Values showed on the control panel during the leakage checks

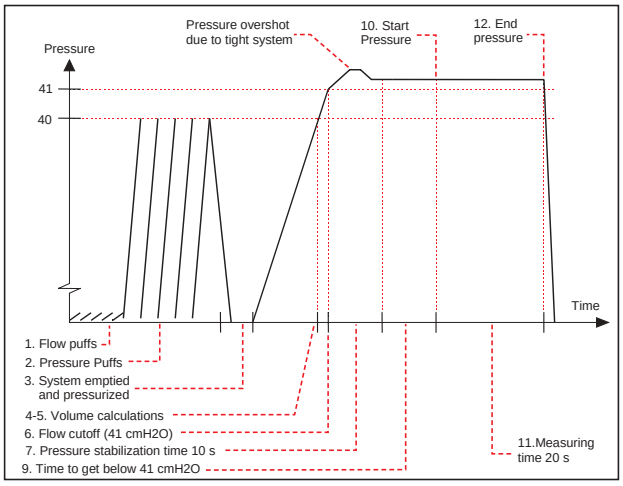


Fig. 2 Pressure diagram – System without leakage

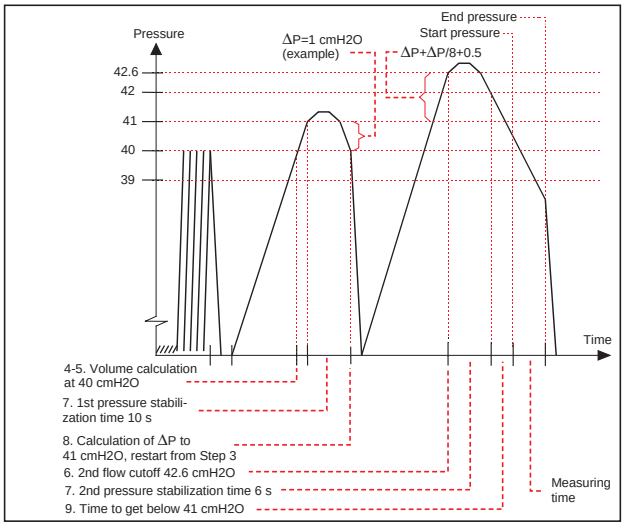


Fig. 3 Pressure diagram – System with leakage, the leakage check will be interrupted

8. If there is a leakage in the system and the pressure drops below 41 cmH2O during this period:
   - System is emptied.
   - A new higher initial pressure, based on the pressure drop, is calculated (max 60 cmH2O).
   - The stabilization period is decreased by 4 s (but always not less than 1s).
   - Re-run from the beginning (Step 2), but without volume calculations.
   - If the pressure drops below 41 cmH2O five times in a row, a technical error code 9907 will be displayed and the check will Fail. *Diagnostic 261, subdata ...26 B3.*
9. Additional stabilization period ending when the pressure drops below 41 cmH2O or stabilization period time has elapsed.
10. Registers the Start time and measures the Start pressure (P1) before the leakage calculation begins.
11. Leakage measuring period of 20 s or until the pressure drops below 39 cmH2O.
    If End pressure is 1 cmH20 higher than Start pressure (P1), a technical error code 9905 will be displayed and the check will Fail.
    Diagnostic 261, Sub-data ...26 B1.
12. Registers the End time and the End pressure (P2).
13. The system calculates “leakage flow” by measuring pressure difference (P1 - P2) over the measuring time (Start time - End time).

$$\text{Leakage} = \frac{\text{System volume} \times (P1 - P2)}{(1013 + \text{Start pressure})} \times \frac{60}{\text{Meas. period}}$$

5

Checking the fresh gas channels

14. If the leakage is below 1000 ml/min, the leakage in the ”fresh gas to vaporizer” and ”fresh gas from vaporizer” channels will now be checked (gas channels between the gas modules and the one-way valve OV4):
    - The system is filled with the “leakage flow” calculated above during 5 seconds.
    - The pressure should now increase. If not, a leakage is detected in these gas channels. Technical error code 9909 will be displayed and the check will Fail.
      Diagnostic 261, Sub data ..26 B5.
15. Evacuates the system by opening all mushroom valves and the PEEP valve.
16. The leakage (ml/min) is shown on the control panel and on the KION Monitor
    - If the leakage is below 150 ml/min, the leakage is accepted and next check will start automatically.
    - If the leakage exceeds 150 ml/min, the test will Fail and the PuC will be paused. The user can select Redo Test to repeat the check or Continue to proceed with next check.
      Diagnostic 262.

Technical error codes if the PuC fails

- A technical error code may be shown on the KION Monitor and on the control panel.
- The failure will also be shown in the Diagnostic Log and the CPS/IDS Diagnostic Log.

Leakage manual ventilation

Checking the patient unit

1. All mushroom valves in the patient cassette are opened. In this way, the complete system is checked.
2. The test is performed like in automatic ventilation but the max. measuring period is extended from 20 to 50 s. The start pressure is 25 cmH2O since most manual breathing bags are very elastic and thus 41 cmH2O can never be reached.
3. If a leakage is detected:
    - If the leakage is below 150 ml/min, the leakage is accepted and next check starts automatically. The leakage (ml/min) is shown on the control panel and on the KION Monitor.
    - If the leakage exceeds 150 ml/min, the test will Fail and the PuC will be paused. The user can select Redo Test to repeat the check or Continue to proceed with next check. The leakage (ml/min) is shown on the control panel and on the KION Monitor.
      Diagnostic 264.
    - If the leakage exceeds 6 l/min, the test will Fail and the PuC will be paused. The user can select Redo Test to repeat the check or Continue to proceed with next check.
      A Technical error code is shown on the control panel and on the KION Monitor.
      Diagnostic 263.

Technical error codes if the PuC fails

- A technical error code may be shown on the KION Monitor and on the control panel.
- The failure will also be shown in the Diagnostic Log and the CPS/IDS Diagnostic Log.

Checking pressure transducers

A check that the pressure transducers works properly is made in PuC.

1. To create a closed system, the following valves are closed:
   - PEEP valve
   - Fresh gas valve
   - MV1
   - MV5.
2. The system is pressurized, manual breathing bag excluded, with a fresh gas flow of 100 ml/s until the INSP pressure is 10 cmH2O or 10 s has elapsed.
3. If the measured INSP pressure is between 6-14 cmH2O, the check continues. If not, the check will Fail, see Note 1.
4. Opens the manual ventilation valves MV1 and MV5.
5. Fills the system, including the manual breathing bag, with a mixer flow of 300 ml/s until the INSP pressure is 10 cmH2O or 30 s has elapsed.
6. If all pressure transducers (INSP, EXP, PEEP and MAN) measures a pressure between 6-14 cmH2O, the check continues. If not, the check will Fail, see Note 2.
7. Fills the system, including the manual breathing bag, with a fresh gas flow of 300 ml/s until the INSP pressure is 20 cmH2O or 30 s has elapsed.
8. If all pressure transducers (INSP, EXP, PEEP and MAN) measures a pressure between 16-24 cmH2O, the check continues. If not, the check will Fail.
9. Evacuates the system during 2 s by opening the PEEP valve.
10. If all pressure transducers (INSP, EXP, PEEP and MAN) measures a pressure between –4 to +4 cmH2O, the check will Pass. If not, the check will Fail, see Note 2.
11. The result of the check is showed on the KION Monitor as Pass or Fail.

Note 1: Diagnostic (265) will be shown in the Diagnostic Log if the test fails. The reached measured INSP pressure can be read from the subdata in the CPS/IDS Diagnostic Log.

Note 2: All Diagnostic (266-269) will be shown in the Diagnostic Log if the test fails. The measured pressure for each transducer can be read from the subdata in the CPS/IDS Diagnostic Log.

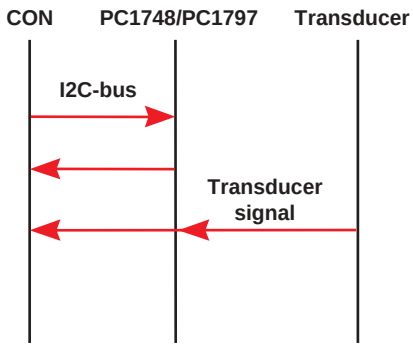
Checking flow transducers

The flow transducer "check" performed in the PuC is actually a calibration of the fresh gas flow transducer and the expiratory flow transducer.

Fresh gas flow transducer calibration

The fresh gas flow transducer pre-amplifier is located on PC1748/PC1797 Fresh gas flow. Adjustment of the pre-amplification (E2-potentiometers) is performed by CON.

During calibration, the signals are routed via the I2C bus.



Offset calibration

1. The gas supply from the gas modules are cut-off and there is no gas flow in the system during offset calibration of the fresh gas flow transducer.
2. The fresh gas flow transducers E2-potentiometers are adjusted during calibration until the measured flow is close to zero.
3. The Tidal Volume display shows the value: 50.
4. The Exp. Tidal Volume display shows the measured flow, as a value counting downwards, by the fresh gas transducer while calibrating (in 1/10 ml/s).

Gain calibration

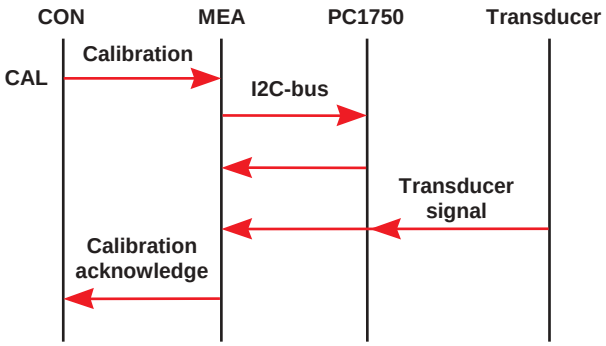
5. The fresh gas flow from the AIR (N2O) or O2 gas modules are 5 l/min (target value) during the gain calibration of the fresh gas flow transducer E2-potentiometer.
6. The fresh gas flow transducers E2-potentiometers are adjusted during calibration until the measured flow is close to the target value.
7. The Tidal Volume display shows the value: 833 (=83.3 ml/s = 5 l/min).
8. The Exp. Tidal Volume display shows the measured flow by the fresh gas transducer while calibrating (in 1/10 ml/s).
9. If acceptance criteria for successful gain calibration is fulfilled, i.e. measured flow do not differ more than 0.5% from the target value, the PuC will continue. If not,the test will Fail, see Note 1.

Note 1: The result of the calibration are shown on the KION Monitor as Pass or Fail. Fail means that either one or both of the fresh gas flow transducer or expiratory flow transducer calibration failed. Diagnostic (270) will be shown in the Diagnostic Log and the CPS/IDS Diagnostic Log if the fresh gas flow transducer calibration failed.

Expiratory flow transducer calibration

The expiratory flow transducer is located in the patient cassette and the preamplifier on PC 1750 TRANSDUCER. Adjustment of the pre-amplification (E2-potentiometers) is performed by MEA.

During calibration, the signals are routed via the CAN bus and the I2C bus.



Offset calibration

1. The gas supply from the gas modules are cut-off and there is no gas flow in the system during offset calibration of the expiratory gas flow transducer.
2. The expiratory flow transducers E2-potentiometers are adjusted during calibration until the measured flow is close to zero.
3. The Tidal Volume display shows the value: 0.
4. The Exp. Tidal Volume display shows the measured flow, as a value counting downwards, by the expiratory flow while calibrating (in 1/10 ml/s).

Gain calibration

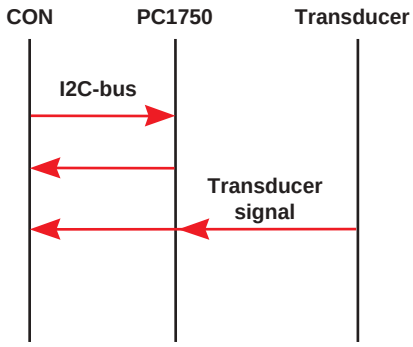
5. CON starts to simulate expirations at several attempts with a duration time of 3 seconds meanwhile a fresh gas flow of 14 l/m is generated.
   Target volume: 14 l/min x 3 s / 60 = 700 ml.
6. The expiratory flow transducers E2-potentiometers are adjusted by MEA on every attempt until the measured volume is close to the target volume 700 ml. Between every attempt the expiratory flow transducer is zeroed.
7. The Tidal Volume display shows the value: 700.
8. The Exp. Tidal Volume display shows, after each attempt, the measured volume by the expiratory flow transducer (in ml).
9. The adjustment of the E2-potentiometers is completed when the expiratory flow transducer output value is ±1% of the target volume.
10. The calibration is interrupted after 14 attempts and if the calculated volume is not close to target volume, the test will Fail, see Note 1.

Note 1:The result of the calibration is shown on the KION Monitor as Pass or Fail. Fail means that either or both of the fresh gas flow transducer or expiratory flow transducer calibration failed.
Diagnostic (271) will be shown in the Diagnostic Log and the CPS/IDS Diagnostic Log if the expiratory flow transducer calibration failed.

Checking bellows level detector

The Bellows position sensor sensitivity is adjusted by CON via four E2- potentiometers in a cascade coupling on PC 1750 TRANSDUCER. The first one controls values from 0 - 63, the second values between 63 - 126 etc. up to 252. 0 is the highest sensitivity.

During calibration, the signals are routed via the I2C bus.



1. The valves are opened in the system to empty the Breathing bellows.
2. The Breathing bellows is emptied (depressed) by a flow of 30 l/min from the drive gas module.
   If the bellows is not detected to be in lowest position after 30 seconds, i.e. the PEEP Pressure - Insp. pressure < 17.5 cmH2O. the test will Fail.
   Diagnostic 232, subdata ..00 02.

Calibration Step 1

3. When Breathing bellows is in its lowest position, the position sensor is calibrated for the bellows position "empty". Starting with 0 (most sensitive) and stepping upwards until no indication is detected.
4. The adjustment of the E2-pots is shown on the Tidal Volume display.
   If communication fails over the I2C-bus, the test will Fail. *Diagnostic 274, subdata ..00 0A*.
5. The Breathing bellows is filled with a flow of 27 l/min from the AIR (N2O) or O2 gas modules to move the bellows to top position.
   If the bellows is not detected to be in top position after 30 s, i.e. the Exp. Pressure - PEEP Pressure < 15 cmH2O, the test will Fail.
   Diagnostic 232, subdata ..00 05.

Calibration Step 2

6. When the Breathing bellows is in top position, the position sensor is calibrated for the bellows position "full". Starting with 0 (most sensitive) and stepping upwards until no indication is detected.
7. The adjustment of the E2-pots is shown on the Tidal Volume display.
   If communication fails over the I2C-bus, the test will Fail. *Diagnostic 274, subdata ..00 0A*.
8. After these two steps, the sensitivity value is adjusted to assure that the bellows position sensor detects the white ring on the bellows.
9. The sensitivity difference value between the two positions is shown on the Exp. Minute Volume display.
   If the two positions values are too close to each other (less than 5 units), the test will Fail.
   Diagnostic 274, subdata ..00 0B.

Final Check

10. When the Bellows position sensor has been calibrated, a test is made to check if the position sensor correctly detects the top position.
11. The valves are opened to empty the Breathing bellows.
12. When 3 s has elapsed, the position sensor signal is read. The bellows should now have fall down to it's lowest position.
    If the position sensor signal still detects that the bellows is in top position, the test will Fail.
    Diagnostic 273.
13. The Breathing bellows is filled with a with a flow of 27 l/min from the AIR (N2O) or O2 gas modules to move the bellows to top position again.
    If the bellows is not detected to be in top position after 30 s, i.e. the Exp. Pressure - PEEP Pressure < 15 cmH2O the test will Fail.
    Diagnostic 232, subdata ..00 0B.
14. The position sensor signal is read. The Breathing bellows should now be in top position.
    If the position sensor signal still detects that the bellows is in lowest position, the test will Fail.
    Diagnostic 272.

Checking mushroom valves

The check of the mushroom valves is made by pressurizing a mushroom valve on one side and check that no pressure is built-up on the other side. Thereafter, the mushroom valve is opened and a verification is made to check that the pressure is equalized on both sides of the valve.

1. The mushroom valves test is performed one valve at a time in the following order: MV1, MV2, MV3, MV4, MV5, OV12 (OV12 is the one-way valve inside the patient cassette).
2. All the mushroom valves are opened to empty the system.
3. All mushroom valves are closed.

Pressurizing

4. The mushroom valve is first pressurized on one side with a flow of 15 l/min to 10 cmH2O. Thereafter with a flow of 5 l/min to a higher pressure level.
   - The gas used for pressurizing the mushroom valve is dependent on which valve to be tested, see the table below.
   - If the pressure level is not reached within 27 s, the test will Fail. One of the mushroom valves is leaking or not closing, *Diagnostic 275.*
   - The pressure level, and which pressure transducer to be used, is dependent on the valve to be tested, see table below:

Tested valve	Pressure cmH2O	Gas used	Mushroom valves open during the test
MV1	INSP > 25	Fresh gas	None
MV2	INSP > 25	Fresh gas	None
MV3	INSP > 25	Fresh gas	None
MV4	PEEP > 25	Drive gas	MV2
MV5	MAN > 15	Drive gas	MV1,MV2
OV12	INSP > 25	Fresh gas	None

Leakage Test

5. The pressurizing flow is turned off.
6. To ensure that there is no leakage at the mushroom valve, the pressure should not increase on the other side of the valve.
   - If there is an unacceptable pressure increase on the other side of the mushroom valve, the test will Fail. This indicates a leakage at one of the mushroom valves. *Diagnostic 276.*
   - Acceptable pressure increase, and which pressure transducer to be used during the test, is dependent on the valve to be tested, see table below:

Tested valve	Pressure cmH2O	Mushroom valves open during the test
MV1	MAN < 10	None
MV2	PEEP < 10	None
MV3	PEEP < 10	None
MV4	INSP < 10	MV2
MV5	INSP < 10	MV1,MV2
OV12	MAN < 10	None

Opening Test

7. The mushroom valve to be tested is opened.
8. The pressure should now be equalized on both sides of the mushroom valve.
   - If the pressure is not equalized on both sides of the mushroom valve, the test will Fail. The tested mushroom valve is not opened or there is a leakage at another mushroom valve *Diagnostic 277.*
   - Acceptable pressure equalization criteria is dependent on the valve to be tested, see table below:

Tested valve	Pressure cmH2O	Mushroom valves open during the test
MV1	MAN > INSP - 10	MV1
MV2	PEEP > INSP - 10	MV2
MV3	PEEP > INSP - 10	MV3
MV4	INSP > PEEP - 10	MV4
MV5	INSP > MAN - 10	MV5
OV12	INSP > 10 for 5 s	MV5, see below

   - The MV5 is opened when the OV12 valve is tested. If there is a leakage in OV12, the gas will flow into the manual breathing bag with a pressure decrease as result.
9. The test is re-started from Step 1 when the next mushroom valve is tested.

Checking alarm detectors

To check the HW pressure alarm detection on MEA the system is pressurized.

1. All mushroom valves except MV2 and MV3 are closed. Fresh gas valve is opened and PEEP valve is closed.
2. The gas module generates a constant flow of 3 l/min to pressurize the system. In case of a leakage, this flow will first be increased to 7 l/min and, if necessary, to 15 l/min to assure that the system is pressurized.
3. The system checks that the HW pressure alarm is activated at +5 cmH2O above the set upper pressure limit (UPL). The HW pressure alarm test will Fail if:
   - Alarm is not activated and the INSP pressure is higher than set UPL +10 cmH2O. *Diagnostic 278*.
   - Alarm is activated, but the INSP pressure is less than set UPL. *Diagnostic 278*.
4. Waits 1 s after the HW pressure alarm is activated. The HW pressure alarm test will Fail if:
   - INSP pressure is not decreasing after 1 s. The system is not evacuated probably because MEA do not activate the signal DISABLE_VALVES. *Diagnostic 278*.
5. The result of the check is shown as Pass or Fail on the KION Monitor.

5

Ending the Pre-use check

- The Breathing bellows is emptied. A flow of 30 l/min from the drive gas module is generated to empty the Breathing bellows.
- If the PuC was successful, the counter for ”Number of starts without recommended PuC” will be set to zero. The date will also be saved.
- If the PuC was interrupted by the operator (by selecting Cancel on the KION Monitor or setting the power switch to On) or if any of the checks Failed, the old calibration values for the transducers in the E2-PROMs will be restored.
- The valves are set in position for Manual Ventilation except for the fresh gas valve that is opened.

Calibration

The Operating Manual describes how to perform the semi-automatic Calibration. The KION Monitor path to select Calibration is:

Menu / Monitor Setup / Biomed / Service / Calibration / KION Calibration

or

Menu / KION / Service / KION Calibration (not applicable for SC 9000)

Service Password is required to access the Service menu.

The description below gives a more detailed information about the Calibration. This information can be used e. g. during troubleshooting of the KION / KION-i workstation.

Note: Before starting the Calibration, check that there is no leakage in the workstation. Run the leakage checks included in the PuC. Also check that the Calibration manometer to be used is properly calibrated.

Initialization

1. Calibration instructions are shown on the KION Monitor.
2. CON sets the gas mixture to O_2/Air.

Check of control panel settings and of gas supply

1. The system checks that the Upper Press. Limit (UPL) knob is set between 60 and 80 cmH2O. *Diagnostic (288)* will be shown in the Diagnostic Log if UPL is not set correctly.
2. The system sets a flow of 0.5 l/min during 1.5 s to be generated by the gas modules AIR (N_2O) – BP and DRIVE GAS for self-adjustment of the flow in these gas modules.
3. The gas module AIR (N_2O) – BP generates a flow of 30 l/min.
4. The system checks that the AIR supply pressure is above 2.2 bar during 2.5 s.
5. If AIR supply pressure is above 2.2 bar during 2.5 s, then AIR will be used as the selected gas for the Calibration.
6. The system sets a flow of 0.5 l/min during 1.5 s to be generated by the gas module O_2 – BP for self-adjustment of the flow in this gas module.
7. If the AIR supply pressure drops below 2.2 bar during the 2.5 s, the gas module O_2 – BP generates a flow of 30 l/min.
8. If O_2 is used, the system checks that the O_2 supply pressure is above 2.2 bar during 2.5 s.
9. If O_2 supply pressure is above 2.2 bar during 2.5 s, then O_2 will be used as the selected gas for the Calibration.
10. *Diagnostic (280)* will be shown in the Diagnostic Log if supply gas is missing.

If the UPL knob is not set correctly or if both AIR supply and O_2 supply Fails, the Calibration will not start and the Calibration start-up screen will remain on the KION monitor. Simultaneously, a caution sound is activated.

Calibrating pressure transducers

During calibration, the pressure transducers are identified as follows on the KION Monitor:

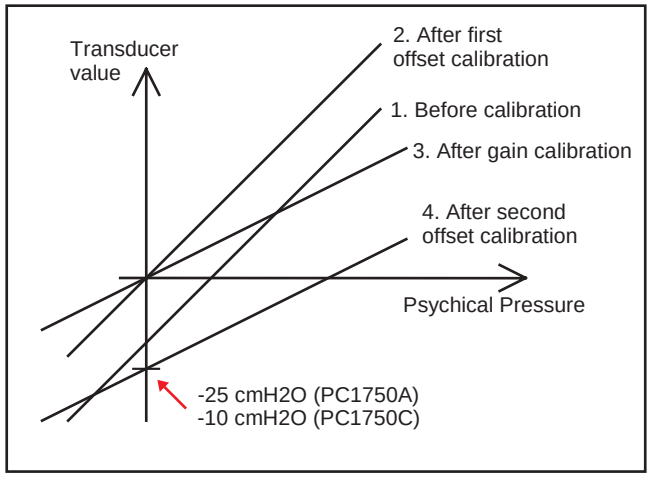
1 = EXP pressure transducer

2 = INSP pressure transducer

3 = PEEP pressure transducer

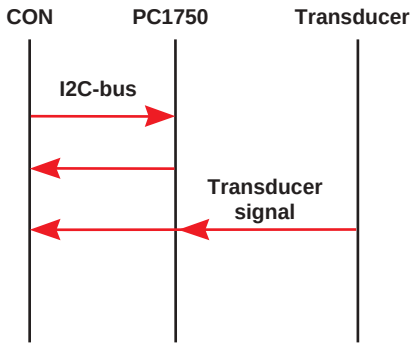
4 = MAN pressure transducer

Pressure transducer calibration sequence



5

PEEP pressure transducer



Offset 1:

1. All mushroom valves except MV1 and MV5 are opened. Also the Fresh gas valve and PEEP valve are opened to depressurize the system.
2. Offset adjustments of the PEEP pressure transducer E2-potentiometers until the transducer value is close to zero.
   - The Tidal Volume display shows the target value: 0.
   - The Exp. Tidal Volume display shows the adjusting transducer value (in 1/100 cmH2O).
   - Fail if communication over the I2C-bus fails or 64 attempts or 30 s has elapsed to adjust pressure transducer E2-potentiometers without being close to the target value. *Diagnostic 281, subdata ...00 0A /...00 0B*.

Gain:

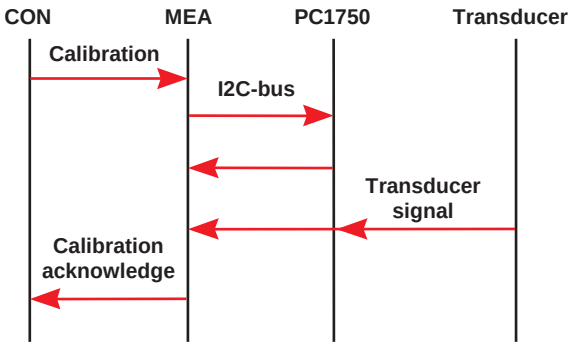
3. The PEEP valve is closed to enable the system to be pressurized.
4. The operator is demanded to pressurize the system by setting a flow using the Fresh Gas Flow knob and to enter the pressure value read on the calibration manometer using the Preset O_2 Conc. knob. The value shown on the Fresh Gas Flow display is proportional to the flow generated by the gas module, approx. 0 – 992 ml/min.
5. Gain adjustments of the PEEP pressure transducer E2-potentiometers until the transducer value is close to the system pressure set by the user.
   - The Tidal Volume display shows the target value (in 1/100 cmH2O), i.e. the system pressure set by the user.
   - The Exp. Tidal Volume display shows the adjusting transducer value (in 1/100 cmH2O).
   - Fail if communication over the I2C-bus fails or 64 attempts or 30 s has elapsed to adjust pressure transducer E2-potentiometers without being close to the target value. *Diagnostic 281, subdata ...00 0E /...00 0F*.

Offset 2:

6. All mushroom valves except MV4 are opened. Also the PEEP valve is opened to depressurize system.
7. The offset adjustments of the PEEP pressure transducer E2-potentiometers is repeated but with a negative offset (-25 cm H_2O or -10 cmH2O if PC1750C is used) to enable measurement of negative pressures.
   - The Tidal Volume display shows the target value: 2500 (1000 with PC1750C).
   - The Exp. Tidal Volume display shows the adjusting transducer value (in 1/100 cmH2O).
   - Fail if communication over the I2C-bus fails or 64 attempts or 30 s has elapsed to adjust pressure transducer E2-potentiometers without being close to the target value. *Diagnostic 281, subdata ...00 0C /...00 0D*.
8. If the calibration of PEEP fails, the INSP and EXP transducer calibration is not performed.

EXP and INSP pressure transducer

The calibration of the EXP and INSP pressure transducers are made only if the PEEP transducer calibration was completed successfully.



Offset 1:

9. All mushroom valves except MV1 and MV5 are opened. Also the Fresh gas valve and PEEP valve are opened to depressurize the system.
10. Offset adjustments of the EXP and INSP pressure transducer E2-potentiometers until the transducer value is close to zero (+15 cmH20 with PC1750C)
    - The Tidal Volume display shows the target value: 0 (102 with PC1750C, A/D value).
    - The Exp. Tidal Volume display shows the adjusting transducer value. Note that the values displayed is converted from cmH20 to the corresponding A/D-value.
    - Fail if 64 attempts or 30 s has elapsed to adjust pressure transducer E2-potentiometers without being close to the target value. *Diagnostic 282/283, subdata ...00 0B.*

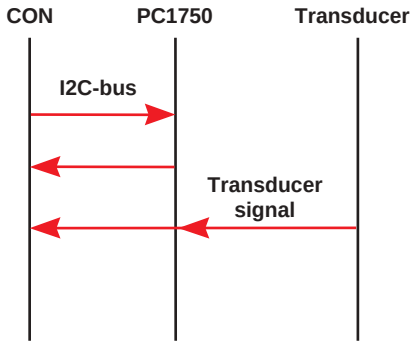
Gain:

11. The PEEP valve is closed to enable the system to be pressurized.
12. The system is pressurized to 6/7 of the pressure level set by the user above (target value). The drive gas module regulates to a stable pressure level with the already calibrated PEEP pressure transducer as reference.
    - Fail if the PEEP pressure is not within [(6/7 x target value) -1 cmH2O] < PEEP < [(6/7 x target value) + 10 cmH2O] for 4 s. *Diagnostic 286, subdata ...00 13.*
13. The system pressure is increased to the pressure level set by the user above (target value).
    - Fail if the PEEP pressure is not within [target value -1 cmH2O] < PEEP < [target value + 10 cmH2O] for 4 s. *Diagnostic 286, subdata ...00 15.*
14. Gain adjustments of the EXP and INSP pressure transducer E2-potentiometers until the transducer value is close to the system pressure.
    - The Tidal Volume display shows the system pressure (target value). Note that the values displayed are converted from cmH20 to the corresponding A/D-value.
    - The Exp. Tidal Volume display shows the adjusting transducer value. Note that the values displayed are converted from cmH20 to the corresponding A/D-value.
    - Fail if 64 attempts or 30 s has elapsed to adjust pressure transducer E2-potentiometers without being close to the target value. *Diagnostic 282/283, subdata ...00 0F.*

Offset 2:

15. All mushroom valves except MV4 are opened Also the PEEP valve is opened to depressurize the system.
16. The offset adjustments of the EXP and INSP pressure transducer E2-potentiometers is repeated, but with a negative offset (-25 cm H_2O or -10 cmH2O with PC1750C) to enable measurement of negative pressures.
    - The Tidal Volume display shows the target value: 170 (A/D value).
    - The Exp. Tidal Volume display shows the adjusting transducer value. Note that the values displayed is converted from cmH20 to the corresponding A/D-value.
    - Fail if 64 attempts or 30 s has elapsed to adjust pressure transducer E2-potentiometers without being close to the target value. *Diagnostic 282/283, subdata ...00 0D.*
17. The results of the calibration of pressure transducers 1, 2 and 3 are shown on the KION Monitor with the number of the transducer followed by Pass or Fail.
    If the calibration of PEEP fails, the INSP and EXP transducer calibration is not performed and no Pass/Fail-text is shown for those transducers on the KION Monitor.

MAN pressure transducer



Offset 1:

18. All mushroom valves except MV1 and MV5 are opened. Also the Fresh gas valve and PEEP valve are opened to depressurize the system.
    - Fail if the PEEP pressure is not within -1 cmH2O to 0.5 cmH2O for 4 s. *Diagnostic 286, subdata ...00 02.*
19. Offset adjustments of the MAN pressure transducer E2-potentiometers until the transducer value is close to zero.
    - The Tidal Volume display shows the target value: 0.
    - The Exp. Tidal Volume display shows the adjusting transducer value (in 1/100 cmH2O).
    - Fail if communication over the I2C-bus fails or 64 attempts or 30 s has elapsed to adjust pressure transducer E2-potentiometers without being close to the target value. *Diagnostic 285, subdata ...00 0A /...00 0B*.

Gain:

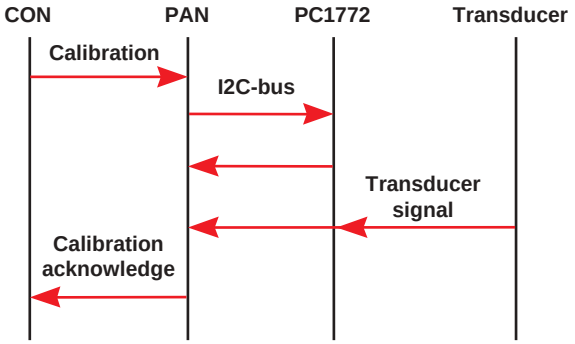
20. The PEEP valve is closed to enable the system to be pressurized.
21. The system is pressurized to +17 cmH2O. The drive gas module regulates to a stable pressure level with the already calibrated PEEP pressure transducer as reference.
    - Fail if the PEEP pressure is not within *+16 cmH2O to +37 cmH2O* for 4 seconds. *Diagnostic 286, subdata ...00 07.*
22. The system pressure is increased to +20 cmH2O.
    - Fail if the PEEP pressure is not within +19 cmH2O to +40 cmH2O for 4 s. *Diagnostic 286, subdata ...00 09.*
23. Gain adjustments of the MAN pressure transducer E2-potentiometers until transducer value is close to the system pressure.
    - The Tidal Volume display shows the system pressure (target value).
    - The Exp. Tidal Volume display shows the adjusting transducer value (in 1/100 cmH2O)
    - Fail if communication over the I2C-bus fails or 64 attempts or 30 s has elapsed to adjust pressure transducer E2-potentiometers without being close to the target value. *Diagnostic 285, subdata ...00 0E /..00 0F*.

Offset 2:

24. All mushroom valves except MV4 are opened, also the Expiratory valve is opened to depressurize system.
    - Fail if the PEEP pressure is not within -1 cmH2O to 0.3 cmH2O for 4 s. *Diagnostic 286, subdata ...00 0D.*
25. The offset adjustments of the MAN pressure transducer E2-potentiometers is repeated, but with a negative offset (-25 cm H_2O or –10 cmH2O with PC1750C) to enable measurement of negative pressures.
    - The Tidal Volume display shows the target value: 2500 (1000 with PC1750C).
    - The Exp. Tidal Volume display shows the adjusting transducer value (in 1/100 cmH2O).
    - Fail if communication over the I2C-bus fails or 64 attempts or 30 s has elapsed to adjust pressure transducer E2-potentiometers without being close to the target value. *Diagnostic 285, subdata ...00 0C /...00 0D*.
26. The result of the calibration of MAN pressure transducer is shown on the KION Monitor with the number 4 followed by Pass or Fail.

Checking barometer

The barometric pressure value is used by the KION / KION-i workstation to increase the accuracy of the of gas supply regulation in the gas modules.



1. The actual measured barometric pressure is shown on the Tidal Volume display. The operator is demanded to adjust this value (if necessary) using the Fresh Gas Flow knob to enter a new value.
   Note: The Fresh Gas Flow knob may reach its end position before the correct value is reached in the Tidal Volume display. If so, turn the knob in the opposite direction to reach correct value.
2. Adjustments of Barometer pressure transducer E2-potentiometers until the transducer value is close to entered value by the user.
   - Fail if the entered value is greater than 1150 mbar.
   - Fail if all the positions in the E2-potentiometer has been gone through without being close to the target value or the I2C-communication with the E2-potentiometer is broken.
3. The result of the barometer calibration is shown on the KION Monitor as Pass or Fail.

Ending the Calibration

If the Calibration was interrupted by the operator (by selecting Cancel on the KION Monitor or setting the KION power switch to On) or if any of the Calibrations failed, the old values in the E2-potentiometer will be restored.

Software installation

There are a number of different softwares included in the KION / KION-i workstation. Perform as follows when updating these softwares:

CON-SW

The CON-software (CON-SW) is stored in a FLASH-PROM on PC 1730 CONTROL. New versions of the CON-SW can be installed either by replacing PC 1730 or by using the Software download tool. Instructions for the software download are enclosed with the download tool.

MEA-PROM

The MEA-software is stored in an exchangable program memory (MEA-PROM) on PC 1737 MEASURING. To update the MEA-software, replace the MEA-PROM.

ALA-PROM

The ALA-software is stored in an exchangable program memory (ALA-PROM) on PC 1672 CONTROL PANEL. To update the ALA-software, replace the ALA-PROM.

PAN-PROM

The PAN-software is stored in an exchangable program memory (PAN-PROM) on PC 1672 CONTROL PANEL. To update the PAN-software, replace the PAN-PROM.

MGI-PROM

The MGI-software is stored in an exchangable program memory (MGI-PROM) on PC 1747 CAN/ RS232 INTERFACE. To update the MGI-software, replace the MGI-PROM.

KION MONITOR-SW

The KION MONITOR-software is stored in the KION Monitor. New software can be installed from a PC Card using the card reader on the KION Monitor.

Perform the software installation as described in the instructions delivered with the PC Card.

CPS-SW alt. IDS-SW

The CPS-SW alt. IDS-SW is stored in the COMMUNICATION INTERFACE (CPS Network PCB alt. IDS Network PCB). New software can be installed from a PC Card using the card reader on the KION Monitor.

Perform the software installation as described in the instructions delivered with the PC Card.

Configure the CPS / IDS

When delivered, the KION / KION-i workstation is configured as a stand-alone unit. A configuration of the CPS/IDS network functions is necessary to perform e. g.:

- When the KION / KION-i workstation will be connected to an INFINITY network.
- When installing a new CPS alt. IDS Network PCB into a KION / KION-i workstation, stand-alone as well as network connected. The default configuration may not work correctly together with the KION Monitor. If so, a “No Screen” alarm will be activated on the KION control panel and the messages “CPS/IDS Access failed” and “OFFLINE” will be shown on the KION Monitor. Furthermore, there will be no access to the CPS/ IDS functions in the KION Monitor service menu.

A complete description of a CPS/IDS configuration for INFINITY Network can be found in the ”INFINITY Network – Planning, design and installation handbook”.

The brief descriptions below shows the main steps of a CPS/IDS configuration.

A PC with the software HyperTerminal (included in Windows) can be used.

- Make sure that the PC and the KION / KION-i workstation is turned Off.
- Connect an RS232 cable (Order No. 47 14 346 E530U to a COM port on the PC.
- Connect the other end of the cable to the X4 port on the KION / KION-i workstation.
- Turn the PC On and the KION / KION-i workstation to Standby.
- Start the terminal program and make the following COM port-settings:
  Bits per second: 19200
  Data bits: 8
  Parity: None
  Stop bits: 1
  Flow control: None

- Press Enter to access the “System console menu”. Make sure that the main menu “CPS 68030 SYSTEM CONSOLE” is displayed.
- Select ”11” – Display/Modify NW Config Data
- Select ”3” – Input all NW Config data
- Press ”Enter” on all suggested settings (to accept default settings) with the following exeptions:
  - Bed label: Type e.g.”BED1”
  - CPS/IDS label: Type e.g. ”OP1”
  - Care Unit label: Type e.g. ”OP”
  - Monitoring unit label: Type e.g. ”MON1”
  - Hospital label: Type e.g. ”Central”.

It is not necessary but recommended to enter ”Recorder label”. This makes it possible to connect a recorder at any time. Type e.g. ”REC1”as name of the primary recorder as well as the secondary recorder.

- Turn the PC and the KION / KION-i workstation Off.
- Disconnect the RS232 cable between the PC and the KION / KION-i workstation.
- Restart the KION / KION-i workstation. The new CPS configuration will now be used.

Display the CPS/IDS configuration

With a PC connected (as previously described) it is also possible to display the CPS/IDS configuration.

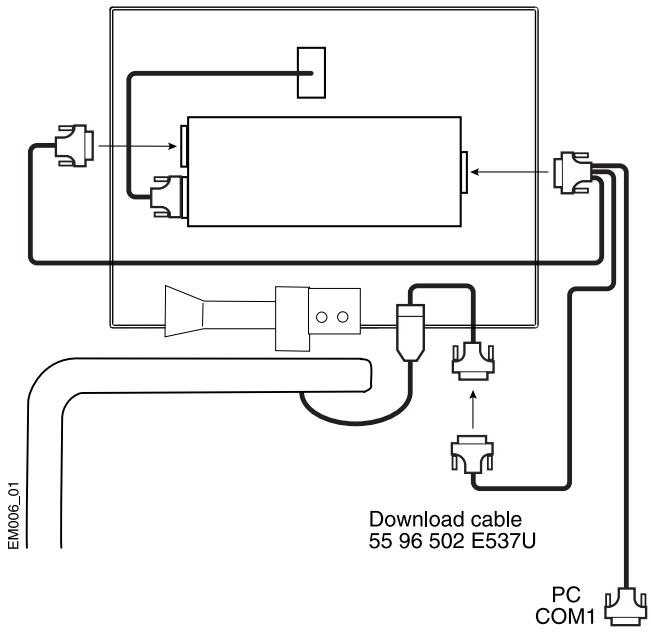
- Access the “System console menu”. Make sure that the “CPS 68030 SYSTEM CONSOLE” is displayed.
- Select ”11” – Display/Modify NW Config Data
- Select ”0” – Display NW Config

The example below shows Network Configuration data for a workstation configured as a stand-alone unit:

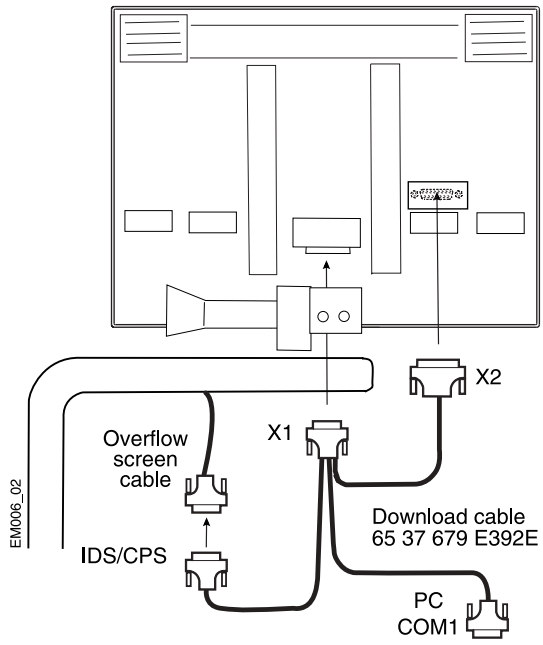
CPS/IDS Host ID: 0
Monitoring unit ID: 1
IP Addr: 191.1.1.0
Subnet Mask: 255.255.0.0
Default Route: 0.0.0.0
Bed Label: BED1
Recorder 1 Label: REC1
Recorder 2 Label:
CPS Label: OP1
Monitoring Unit Label: M1
Care Unit Label: OP
Hospital Label: HOSP
Primary Recorder: REC1
Secondary Recorder: REC1
Primary Alarm Recorder: REC1
Secondary Alarm Recorder: REC1
Remote Silence Enabled: Yes
Remote Control Enabled: Yes
Alarm Group: 0
Will this bedside be monitored by a Central Station?: Yes
Network Mode: Standalone
Recorder Use: Global
Laser Printer IP Addr: 191.1.1.240

The example below shows Network Configuration data for a workstation configured as a network node:

CPS Host ID: 55
Monitoring unit ID: 1
IP Addr: 191.1.1.55
Subnet Mask: 255.255.0.0
Default Route: 0.0.0.0
Bed Label: BED1
CPS/IDS Label: OP1
Monitoring Unit Label: M1
Care Unit Label: OP
Hospital Label: Central
Recorder 1 Label: REC1
Recorder 2 Label: REC1
Primary Recorder: REC1
Secondary Recorder: REC1
Primary Alarm Recorder: REC1
Secondary Alarm Recorder: REC1
Remote Silence Enabled: Yes
Remote Control Enabled: Yes
Alarm Group: 5
Will this bedside be monitored by a Central Station?: No
Network Mode: Networked
Recorder Use: Global
Laser Printer IP Addr: 191.1.1.240
Network Comm Stack Configuration: CPS/IDS Stack
NWeb Server Addr: 0.0.0.0
CPC/IDS Web Server Port: 80



KION DuoView with Serial No. 01000 or lower



KION DuoView with Serial No. 01001 or higher

SDC-SW

The SDC-software is stored in the Surgical Display Controller (SDC) inside the DuoView.

There are two versions of the KION DuoView:

- KION DuoView with S/N 01000 or lower.
- KION DuoView with S/N 01001 or higher.

Both versions uses the same SDC-SW.

A PC and a download cable must be used when installing the SDC-SW. Note that there are different download cables for the two DuoView versions. The adjacent illustrations shows P/N's as well as connection of the download cables.

On DuoView with S/N 01000 or lower, the rear cover must be removed to access the connectors.

A complete description of the software installation can be found in the "Surgical Display Controller – Software Installation Instructions" delivered with the SDC-SW.

Note: The DuoView is power supplied by the KION / KION-i workstation. Thus, the KION / KION-i must be switched to Standby or On during the software installation.

MGA-SW

The MGA-SW for the optional multigas analyzer is stored in the multigas analyzer. There are two different multigas analyzers that can be used:

- KION MultiGas 2000
- KION MultiGas+.

There are different softwares as well as software installation procedures for the two versions.

KION MultiGas 2000

The KION MultiGas 2000 software is stored in two FLASH memories and can be downloaded via a PC connected to the analyzer. The two softwares in the KION MultiGas 2000 are:

- PrC-SW (Protocol Converter Software)
- AION-S (Gas Analyzer Software).

KION MultiGas+

The MultiGas+ software is stored in two exchangable program memories on the MGM SYSTEM BOARD inside the analyzer. The two softwares in the KION MultiGas+ are:

- AMA-PROM (Agent Measurement Analyzer)
- AIDA-PROM (Agent Identification Analyzer).

For further technical information regarding the multigas analyzers, refer to the Service Manual for the concerned unit (KION MultiGas 2000 or KION MultiGas+).

Connecting a PC to the KION/KION-i

A PC can be connected to the KION / KION-i workstation, e.g. to download diagnostic logs. In the description below, a PC with the software HyperTerminal (included in Windows) is used.

Connection and setup

Cable connection

- Make sure that the PC and the KION / KION-i are turned Off.
- Connect an RS232 cable (Order No. 47 14 346 E530U) to a COM port on the PC.
- Connect the other end of the cable to the KION / KION-i as follows:
  - For access to the ”Diagnostic Log”, connect to the X3a port.
  - For access to the ”CPS/IDS Diagnostic Log”, connect to the X4 port.
- Turn the PC On and the KION / KION-i to Standby.

First time-setup

If this is the first time the PC is used for communication with the KION / KION-i, terminal settings must be made. These settings can be saved and used whenever the PC is connected to a KION / KION-i.

- Start HyperTerminal on the PC.
- Select a name (e. g. KION) and an icon. Click OK.
- Select the used COM port in the ”Connect to” dialog box. Click OK.
- Make the following COM port-settings:

Bits per second:	19.200
Data bits:	8
Parity:	None
Stop bits:	1
Flow control:	None

- Click OK.
- The HyperTerminal window will now be open and active.
- Select File/Save in the HyperTerminal menu to save the settings and thereby create a HyperTerminal setting to be used whenever the PC is connected to a KION / KION-i.
- Press the Enter key. The ”System Console Main Menu” will now appear in the HyperTerminal window (if a sub-menu is displayed, return to the ”System Console Main Menu”). Communication with the KION / KION-i is established.

Connection with saved settings

- Start HyperTerminal using the HyperTerminal-setting saved for communication with the KION / KION-i. The HyperTerminal window will now be open and active.
- Press the Enter key. The "System Console Main Menu" will now appear in the HyperTerminal window. If a sub-menu is displayed, return to the "System Console Main Menu". Communication with the KION / KION-i is established.

Disconnecting the PC from the KION / KION-i

- Make sure that the KION / KION-i is turned Off.
- Make sure that the PC is turned Off.
- Disconnect the RS232 cable between the PC and the KION / KION-i.

5

Access the diagnostic logs from a PC

Downloading the diagnostic logs

The HyperTerminal program is used only as an interface for communication with the KION / KION-i:

- Establish communication between the KION / KION-i and the PC (see above).
- Enter selection 1 (Error Services) in the "System Console Main Menu". Press the Enter key. The "ERROR Driver Main Menu" will now appear.
- Select Transfer/Capture text in the HyperTerminal menu.
- Select a name and a path for the target file.
- Click on Start. The target file is now ready to be used.
- Enter selection 1 (View the Error Log) in the "ERROR Driver Main Menu". Press the Enter key. The log will now be copied to the target file.
- Wait until the copying is completed and the "ERROR Driver Main Menu" appears again.
- Select Transfer/Capture text/Stop in the HyperTerminal menu to close the target file.
- Exit the HyperTerminal program.

It is now possible to open the target file with a suitable program, e.g. Notepad. To make it easier to read the information in the log, it is recommended to change the font (use e. g. Arial) and to delete unnecessary parts of the file.

Deleting the diagnostic logs

- Establish communication between the KION / KION-i and the PC (see description above).
- Enter selection 1 (Error Services) in the "System Console Main Menu". Press the Enter key. The "ERROR Driver Main Menu" will now appear.
- Enter selection 5 (Clear the Error Log) in the "ERROR Driver Main Menu". Press the Enter key. The log will now be deleted.
- Exit the HyperTerminal program.

Note: Do not delete the diagnostic logs, e.g. after performed service. In case of future troubleshooting on the workstation, as much relevant log information as possible should be kept. The oldest logs will automatically be overwritten when the log list is full.

Connecting a Recorder and/or a Laser Printer to the KION / KION-i

The KION / KION-i workstation can be connected to an R 50 / R 50-N Recorder and to a Laser Printer.

Note: R 50 Recorder can only be used on KION workstations equipped with a CPS Network PCB, i.e. KION workstations with S/N 03645 or lower. For units equipped with a IDS Network PCB, i.e. KION / KION-i workstations with S/N 03646 or higher, an R 50-N Recorder must be used.

KION / KION-i as a stand-alone unit

The KION / KION-i workstation, as a stand-alone unit, can be connected to an R 50 / R 50-N Recorder and to a Laser Printer.

Note: With KION / KION-i as a stand-alone unit, R 50-N cannot be connected at the same time as a Laser Printer. The same port (X14) is used.

For an R 50-N Recorder or a Laser Printer:

- Connect with an Ethernet Crossover cable to the Ethernet port (X14).
- Configure the CPS / IDS for Recorder and/or for Laser Printer. Refer to section “Configuring the CPS / IDS” in this chapter.

For an R 50 Recorder:

- Connect with a Recorder cable to the R 50 recorder port (X13).
- Configure the CPS / IDS for Recorder. Refer to section “Configuring the CPS / IDS” in this chapter.

KION / KION-i in a network

The KION KION-i workstation, as a node in an INFINITY NETWORK, can be connected to an R 50-N Recorder and to a Laser Printer.

- Connect the R 50-N Recorder and/or the Laser Printer to the INFINITY NETWORK.
- Connect the KION / KION-i to the INFINITY NETWORK via the Ethernet port (X14).
- Configure the CPS / IDS for Recorder and/or for Laser Printer. Refer to section “Configuring the CPS / IDS” in this chapter.

For connection of a R 50 Recorder, refer to “KION as a stand-alone unit” above.

Printing the Diagnostic Log

The path to print the KION Monitor Diagnostic Log is:

Menu / Monitor Setup / Biomed / Logs / Print log

5

Notes

Only personnel trained and authorized by Siemens shall be permitted to perform installation, service or maintenance of the KION / KION-i workstation.

Make sure to prepare the KION / KION-i workstation properly before disassembling and assembling. Refer to section "Hazard notices" in chapter "Important".

Any service or maintenance must be noted in a log book.

Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

After any installation, maintenance or service intervention in the KION / KION-i, perform a "Calibration" and a "Function check".
Refer to the "KION / KION-i anesthesia workstation – Operating Manual" for details.

6. Troubleshooting

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General

Before starting troubleshooting, try to eliminate all possibilities of operational errors. If the malfunction remains, use the troubleshooting guides below as well as the information in chapter "Description of functions" to locate the faulty part. Perform actions step by step and check if the malfunction is eliminated.

When the malfunction is eliminated, carry out a complete "Function check" as described in the Operating Manual.

The troubleshooting guides below are focused only on technical problems. Information about clinical related alarms can be found in the Operating Manual.

During the "Pre-use check", the result of the check is shown on the KION Monitor. However, important technical information, useful during troubleshooting, is also shown in the digital displays on the Control panel. For description of the information shown on the Control panel displays, refer to chapter "Service procedures" and to the "Diagnostic Log table" in this chapter.

For a technical description of the "Pre-use check", refer to chapter "Service procedures".

This chapter is divided into three sections:

- **If the "Pre-use check" fails**: This section describes possible causes and recommended actions if any of the tests included in the "Pre-use check" fails.
- **Other errors and remedies**: This section describes possible causes and recommended actions in case of other technical errors in the KION / KION-i workstation.
- **Diagnostic logs**: This section describes how to read and analyze the Diagnostic logs that are stored in the KION Monitor and in the Communication interface (CPS / IDS).
  A complete Diagnostic Log table is also included in this section. The Diagnostic Logs should be used during troubleshooting of the KION / KION-i workstation.

Required equipment

- Standard service tools.
- Leakage detector. P/N 65 03 721 E392E.
- Rubber plug kit with plugs in different diameters to plug tubes, outlets, etc. during troubleshooting. P/N 65 03 739 E392E.
- Silicone rubber muff. P/N 66 97 262 E037E.
- Calibration manometer. P/N 61 03 527 E037E.
- Pressure Tester 0.2 bar Regulator (REG1). P/N 65 62 479 E392E.
- Support plate adjustment tool. P/N 66 37 529 E392E.
- Voltmeter.
- Leakage detection spray.

Possible causes to malfunction not mentioned in the following troubleshooting guides are:

- The system has not been correctly assembled after cleaning, maintenance or service.
- Disconnection or bad connection in cable connectors, PC board connectors, and inter-connection boards.
- Pinched cables. Defective cables may short-circuit power supply, CAN-bus signals, etc.
- Disconnected or defective gas tubes, breathing gas as well as drive gas. Note: Repeated disconnection/connection of tubes in quick couplings may cause a leakage.

These possible causes to malfunction must always be concidered during troubleshooting.

If the ”Pre-use check” fails

Before starting the leakage checks described in this chapter, make sure that the leakage checks as described in the Operating Manual, chapter ”Troubleshooting”, section Instructions if Pre-use check fails”, are performed. The leakage checks in the Operating Manual are basic checks of the CO_2 absorber and the patient cassette.

The first recommended troubleshooting actions if the Pre-use check (PuC) fails are:

1. Check for leakages, e.g. by performing the Leakage automatic ventilation and Leakage manual ventilation parts of the PuC.
2. Calibrate
3. Perform a complete PuC.

Leakage in automatic and manual ventilation-test fails

Two leakage checks are performed during the PuC:

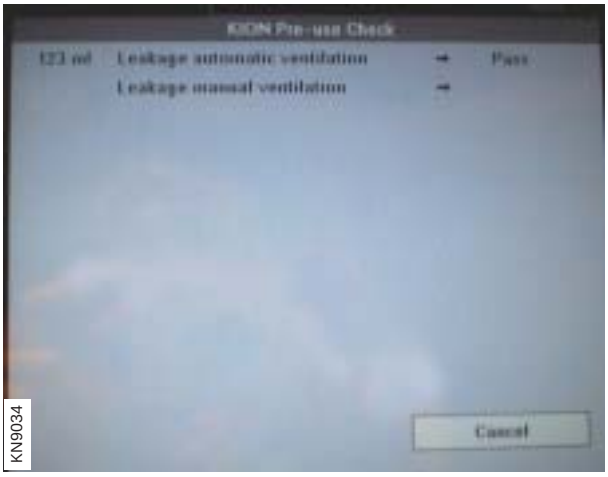
- Leakage automatic ventilation
- Leakage manual ventilation.

If either the Leakage automatic ventilation or Leakage manual ventilation check fails, the leakage volume in ml or a technical error code will be displayed. The conditions for the leakage checks are:

- If the leakage is max. 150 ml/min, the checks will Pass.
- If the leakage is 151 ml/min – 5.999 ml/min, the checks will Fail and the leakage in ml will be shown.
- If the leakage exceeds 6 l/min, the checks will Fail and a technical error code will be shown.

Leakage max. 150 ml/min

The leakage check passed.



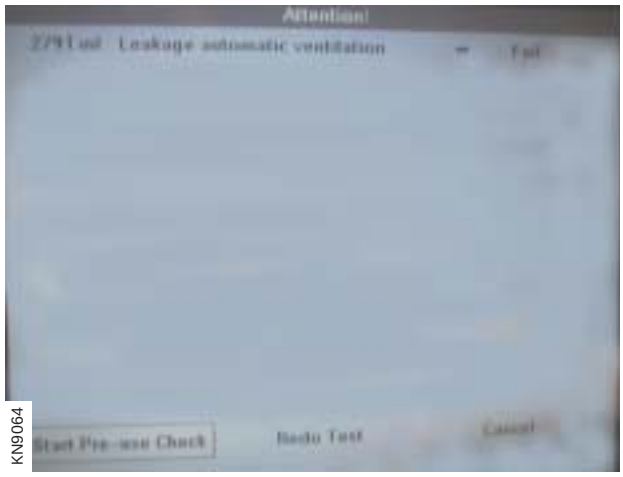
KION Monitor – The leakage in ml/min is shown to the left of the leakage check texts in the PuC window.

Recommended action

No action is required, but if the PuC is performed as a final check after service or maintenance, a max. leakage of approx. 100 ml/min is recommended. Refer to section “Check for leakage” in this chapter.

Leakage 151 ml/min – 5.999 ml/min

The error is recorded as Diagnostic Log 262 alt. 264.



KION Monitor – The leakage in ml/min is shown to the left of the leakage check texts in the PuC window.

Recommended action

Check for leakages in the workstation. Refer to section “Check for leakage” in this chapter.

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Leakage exceeds 6 l/min – Technical error codes

The error is recorded as Diagnostic Log 261 alt. 263.

KION Monitor – A four digit code 990X, shown to the left of the leakage check texts in the PuC window.

KION/KION-i control panel – A single digit code 1-9, stated in the digital display for CMV. The digit corresponds to the 4th digit in the technical error code.

Recommended actions

Code **9901**: Software loading failure:

Problem when loading / reading the software in KION/KION-i.

1. Power-cycle KION/KION-i.
2. Replace PC 1730 Control.

Code **9902**: Leakage >19 l/min (disconnect):

Test pressure was not obtained within 15 s; the leakage check fails. Obtained pressure is shown in the digital display “Fresh gas flow“.

1. Make sure that the basic leakage checks are performed. Refer to the Operating Manual, chapter ”Troubleshooting”
2. Check for leakages in the workstation. Refer to section “Check for leakage” in this chapter.

Code **9903**: Software loading failure:

Start pressure mean value cannot be calculated.

1. Power-cycle KION/KION-i.
2. Replace PC 1730 Control.

Code **9904**: Software loading failure:

End pressure mean value cannot be calculated.

1. Power-cycle KION/KION-i.
2. Replace PC 1730 Control.

Code **9905**: Gas leakage into the workstation:

End pressure more than 1 cmH_2O above Start pressure.

1. Make sure that the basic leakage checks are performed. Refer to the Operating Manual, chapter ”Troubleshooting”
2. Check for leakages into the workstation. Refer to section “Leakage into the system” in this chapter.

Code **9906**: The workstation is not evacuated:

The system is not evacuated within 10 s after the last pressure increase. Remaining pressure, shown in the digital display “Fresh gas flow“, is above 1.5 cmH_2O.

1. Make sure that the basic leakage checks are performed. Refer to the Operating Manual, chapter ”Troubleshooting”
2. Check the mushroom valve function.
3. Check the PEEP valve function.
4. Check for leakages into the workstation. Refer to section “Leakage into the system” in this chapter.

Code **9907**: Leakage 6-19 l/min:

Test pressure could not be kept though 5 attempts were made; the PuC could not be completed. Obtained start pressure is shown in the digital display “Fresh gas flow“.

1. Make sure that the basic leakage checks are performed. Refer to the Operating Manual, chapter ”Troubleshooting”
2. Check for leakages in the workstation. Refer to section “Check for leakage” in this chapter.

Code **9908**: Software loading failure:

Communication error between KION/KION-i and KION Monitor.

1. Power-cycle KION Monitor.
2. Power-cycle KION/KION-i.
3. Replace PC 1730 Control.

Code **9909**: Gas leakage in the workstation:

Leakage >200 ml/min between the gas modules AIR (N2O) / O2 and the one-way valve OV4.

1. Check for leakages in the workstation. Refer to section “Check for leakage” in this chapter.

Check for leakage

If a leakage of more than 150 ml/min is discovered, either during the Leakage automatic ventilation or during the Leakage manual ventilation, the PuC fails and will be paused. At this stage all mushroom valves are opened.

The table below describes different Test cases to be performed in order to locate leakages. The Test cases are further described after the table.

Section	Component	Test case 1	2	3	4	5	6	7
1. CO_2 absorber	CO2 absorber including internal lid seals	x						
	Absorber connection seals	x						
2. Patient cassette	Valve assembly plate		x					
	Fresh gas inlet seal		x					
	Silicone rubber lid at OV12		x					
	Plastic cover at INSP unidirectional valve		x					
	Plastic cover at EXP unidirectional valve		x					
	Expiratory flow transducer		x					
	Expiratory flow transducer silicone muff		x					
	Breathing bellows seal		x					
	APL valve including O-rings		x					
	Manual breathing bag inlet connection O-ring		x					
3. Fresh gas line								
Gas module	Nozzle units at the Fresh gas modules			x				
Inspiratory gas block	Cuffs (seals) in the Inspiratory gas block			x				
	SV1 (600 kPa)			x				
	Tube including fittings between Inspiratory gas block and Vaporizer magazine			x				
Vaporizer magazine	O-ring, small			x				
	O-ring, large			x				
	One-way valves OV 9, OV 10, OV 11			x				
	Vaporizer selection valves 1, 2, 3			x				
	Tube including fittings between Vaporizer magazine and Fresh gas container			x				
Fresh gas container	Diaphragm			x				
	SV3 (18 kPa)			x				
Fresh gas flow transducer	Fresh gas flow transducer			x				
	Silicone rubber connections			x				
Fresh gas valve	Fresh gas valve tube			x				
Inspiratory gas block	Fitting including OV4			x				
	SV4 (14 kPa)			x				
	Tube including fittings between Inspiratory gas block and Instant O2 Supply block.			x				
Safety valve 8	SV8 (-3.5 kPa) including silicone rubber muff			x				
	Tube between SV8 and Aux. fresh gas outlet			x				
Aux. fresh gas outlet	Auxiliary fresh gas outlet valve			x				

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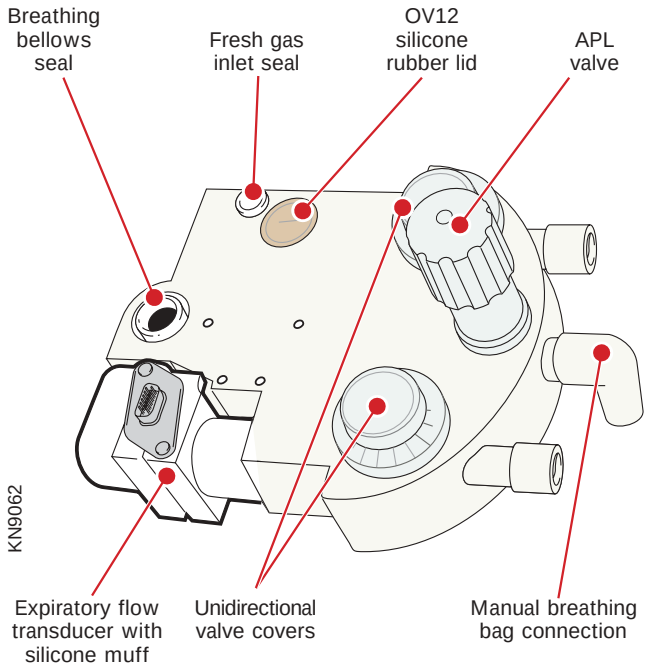
Section	Component	Test case 1	2	3	4	5	6	7
4. Multigas analyzer line								
Sampling line	Sampling line adapter at the Y-piece				x			
	Sampling line				x			
	Water trap				x			
	Water trap receptacle including seals				x			
	Tubing between water trap receptacle and multigas analyzer				x			
Multigas analyzer	Multigas analyzer				x			
	Sampling gas return tube and silicone muff				x			
5. Exhaust gas line and Drive gas line								
Exhaust gas line	Bellows housing					x		
	Bellows housing seal					x		
	Expiratory seal					x		
	Bellows support plate					x		
	Exhaust gas tube					x		
	PEEP transducer including bacteria filter					x		
	PEEP valve tube					x		
	MV2					x		
Drive gas line	Drive gas tube					x		
	SV2 (14 kPa)					x		
	Seal in the inspiratory gas block					x		
	Nozzle unit at the Drive gas module					x		
6. Patient cassette docking station								
	Silicone muff						x	
	Bacteria filters (3 each)						x	
7. Pressure transducers								
	Pressure transducers alt. PC1781 on PC 1750							x
	Tubings incl. fittings on pressure transducers							x



Test case 1: CO_2 absorber

1. By-pass the CO2 absorber (lower the absorber).
2. Redo the PuC.
3. If the PuC passes, the leakage was located to either:
   - CO_2 absorber, or
   - Absorber connection seals.

Test case 2: Patient cassette

1. Replace the patient cassette if another cassette is available.
2. Redo the PuC.
3. If the PuC passes, the leakage was located to the patient cassette including:
   - Valve assembly plate
   - Fresh gas inlet seal
   - Silicone rubber lid at OV12
   - Plasic cover at INSP unidirectional valve
   - Plasic cover at EXP unidirectional valve
   - Expiratory flow transducer
   - Expiratory flow transducer silicone muff
   - Breathing bellows seal
   - APL valve including O-rings
   - Manual breathing bag inlet connection O-ring.

Test case 3: Fresh gas line

1. Open the Auxiliary fresh gas outlet valve and plug the outlet.
2. Connect the leakage detector to the Vaporizer magazine inlet connector (left connector).
3. Pressurize to 40–50 cmH_2O.
4. During this test case, the complete fresh gas line is checked. All parts included are listed in the table above. If a leakage is determined, continue with the sub-test cases 3.1 – 3.4.

   Note: The sub-test cases only locate leakages to a certain section of the workstation. To find the source of the leakage, try to divide the fresh gas line into smaller sections. Plug and pressurize until the faulty component is located.

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Test case 3.1:

1. Connect the leakage detector to the vaporizer magazine outlet connector (right connector).
2. Depress the vaporizer interlock.
3. Pressurize to 40–50 cmH_2O.
4. The following parts are checked during this test case:
   - Nozzle units at the fresh gas modules.
   - Cuffs. Seals in the inspiratory gas block for the fresh gas module connection.
   - SV1 (600 kPa).
   - Tube including fittings between Inspiratory gas block and Vaporizer magazine.
   - Small O-ring in the vaporizer magazine hub.

Test case 3.2:

1. Divide the Fresh gas line in two sections by removing the fresh gas valve tube.
2. Visually check the fresh gas valve tube.

Test case 3.3

KN9088

1. Plug the fresh gas flow transducer outlet at the fresh gas valve.
2. Connect the leakage detector to the Vaporizer magazine inlet connector (left connector).
3. Pressurize to 40–50 cmH_2O.
4. Test case 3.3 is an extension of Test case 3.1 and involves testing of parts according to 3.1, plus the below listed items. Thus, if Test case 3.3 fails whereas Test case 3.1 passes, it points to a defect or a leakage at any of the below items.
   - Large O-ring in the vaporizer magazine hub.
   - One-way valves OV9, OV10 and OV11. Note: To check all three valves, the leakage detector must be connected to two different inlet connectors.
   - Vaporizer selection valves 1, 2 and 3.
   - Tube including fittings between Vaporizer magazine and Fresh gas pressure container.
   - Diaphragm inside Fresh gas pressure container.
   - SV3 (18 kPa)
   - Fresh gas flow transducer
   - Silicone rubber connections (2 each) for the flow transducer.

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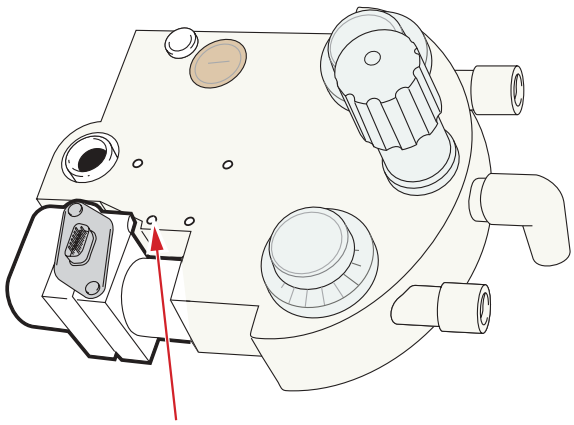
Test case 3.4

1. Connect the leakage detector to the Auxiliary fresh gas outlet. Make sure that the valve is open.
2. Plug the Fresh gas valve connection on the Inspiratory gas block.
3. Pressurize to 40–50 cmH_2O.
4. The following parts are checked during this test case:
   - Fitting including OV4.
   - SV4 (14 kPa).
   - Tube including fittings between the Inspiratory gas block and the Instant O2 Supply block.
   - SV8 (-3.5 kPa) including silicone rubber muff.
   - Tube between SV8 and the Auxiliary fresh gas outlet valve.
   - Auxiliary fresh gas outlet valve.



KN9063

Test case 4: Multigas analyzer line

1. Bypass the multigas analyzer:
   - Remove the multigas sampling line adapter from the Y-piece.
   - Block the sampling gas inlet on the patient cassette, e.g. by covering the hole with a piece of adhesive tape.
2. Redo the PuC.
   Note: After the “Leakage automatic ventilation” or the ”Leakage manual ventilation” test is done, cancel the PuC and remove the tape to prevent pump damages.
3. If “Leakage automatic ventilation” test passes, the malfunction was located to the multigas analyzer line. Check the following parts:
   - Sampling line adapter.
   - Sampling line.
   - Water trap.
   - Water trap receptacle including seals.
   - Tubes between the water trap receptacle and the multigas analyzer.
   - Multigas analyzer. For leakage checks, refer to the service manual for the concerned multigas analyzer.
   - Multigas analyzer return gas tube including the Docking station silicone muff.

Bellows housing seal

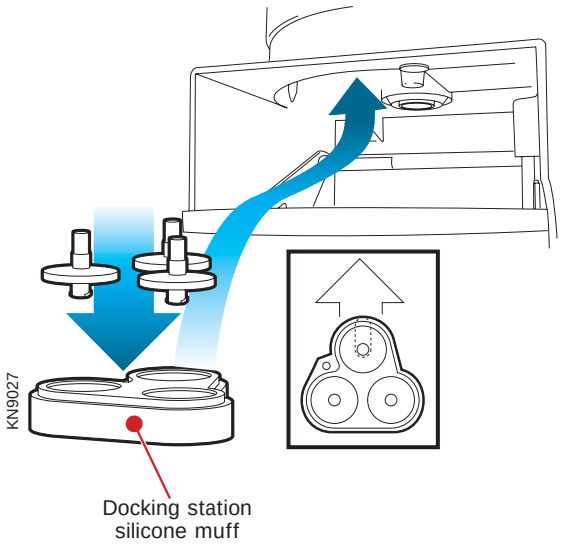
Expiratory seal

Test case 5: Exhaust gas line and Drive gas line

1. Cancel the PuC. Check that the power switch is in Standby.
2. Disconnect the PEEP valve tube at Evac side.
3. Connect the leakage detector to the PEEP valve tube. Refer to the illustration.
4. Pressurize to 40–50 cmH_2O.
5. The following parts are checked during this test case:
   - Bellows housing
   - Bellows housing seal
   - Expiratory seal
   - Bellows support plate
   - Exhaust gas tube
   - PEEP transducer including bacteria filter
   - PEEP valve tube
   - APL valve (also included in Test case 2)
   - MV2
   - Drive gas tube
   - SV2 (14 kPa)
   - Seal in the inspiratory gas block for the Drive gas module connection.
   - Nozzle unit at the Drive gas module.

Test case 5.1: By-passing the Drive gas line

1. If there is a leakage in Test case 5, separate the Drive gas line from the Exhaust gas line by blocking the Drive gas inlet of the bellows base plate with a piece of adhesive tape.
   Note: Make sure to remove the tape after the test.
2. Re-assemble the Bag-in-bottle unit.
3. Pressurize at the PEEP valve tube according to Test case 5.
4. If Test case 5 fails whereas Test case 5.1 passes, it points to a defect or a leakage in the Drive gas line, i.e. at any of the below items:
   - Drive gas tube
   - SV2 (14 kPa)
   - Seal in the inspiratory gas block for the Drive gas module connection.
   - Nozzle unit at the Drive gas module.



Test case 6: Patient cassette docking station

1. Remove the docking station silicone muff including the 3 bacteria filters.
2. Clean the silicone muff if required.
3. Check / replace the bacteria filters.
4. Reinsert the silicone muff gently to prevent damages to the bacteria filters.

Test case 7: Pressure transducers including tubings

1. Check for obstructions or poor connection in the pressure transducer tubes. Check tube connections on the pressure transducers and in the docking station.
2. Replace complete PC 1750 Transducer (old version) or the concerned PC 1781 Pressure transducer (new version).

6

Leakage into the system

Technical error codes 9905 and in some cases also 9906 indicates a leakage into the system. Sources for such leakage are: the Mushroom valves, the Gas modules or the Instant O2 supply block. Check as follows:

Mushroom valves:

1. Check that the mushroom valves are undamaged and correctly mounted on the valve assembly plate.

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Fresh gas modules:

1. Connect the leakage detector to the vaporizer magazine outlet connector (right connector).
2. Depress the vaporizer interlock.
3. If there is a pressure raise indicated on the manometer, it may be a leakage into the system from the gas modules AIR (N_2O) - BP or O_2 - BP. Check the gas modules.

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Instant O2 supply block:

1. Cancel the PuC. Check that the power switch is in Standby.
2. Connect the leakage detector to the auxiliary fresh gas outlet.
3. Open the auxiliary fresh gas outlet valve (lever in horizontal position).
4. If there is a pressure raise indicated on the manometer, it may be a leakage into the system from the Instant O_2 Supply block. Check the Instant O_2 Supply block.

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Gas module for drive gas:

1. Cancel the PuC. Check that the power switch is in Standby.
2. Disconnect the PEEP valve tube at Evac side.
3. Connect the leakage detector to the PEEP valve tube. Refer to the illustration.
4. If there is a pressure raise indicated on the manometer, it may be a leakage into the system from the Drive gas module. Check the Drive gas module.

Checking pressure transducers-test fails

A check that the pressure transducers works properly is made during this sequence of the PuC.

Errors are recorded as Diagnostic Logs 265–269.

1. Make sure that the leakage checks passed.
2. Calibrate the KION/KION-i
3. If the Calibration is successful, redo the PuC.
4. If the Calibration failed due to a malfunction in a pressure transducer, this transducer will be identified. The pressure transducer number will be shown on the KION Monitor as follows:

   1 = EXP pressure transducer

   2 = INSP pressure transducer

   3 = PEEP pressure transducer

   4 = MAN pressure transducer.

   In case of pressure transducer malfunction:

   - Check for obstructions or poor connection in the pressure transducer tubes. Check tube connections on the pressure transducers and in the docking station
   - Replace the complete PC 1750 Transducer (old version)
   - Replace the concerned pressure transducer PC 1781 (new version).
5. Redo the Calibration.
6. Redo the PuC. If the test still fails, report to EM-HSC.

Checking flow transducers-test fails

The flow transducers are tested and calibrated during this sequence of the PuC.

Errors are recorded as Diagnostic Logs 270–271.

The Diagnostic Logs shows if it is the Fresh gas flow or Expiratory flow measuring that fails. Furthermore, the different steps in this test are indicated on the Control panel. This information also makes it possible to identify if it is Fresh gas flow or Expiratory flow measuring that fails.

1. Make sure that the leakage checks passed.
2. If the Fresh gas flow measuring fails:
   - Refer to information in the subdata description for Diagnostic Log 270.
3. If the Expiratory flow measuring fails:
   - Refer to information in the subdata description for Diagnostic Log 271.
4. Redo the PuC after each action. If the test still fails, report to EM-HSC.

Checking bellows level detectors-test fails

During this sequence of the PuC, it is checked whether the Bellows position sensor is able to detect the white plastic ring on the upper part of the breathing bellows.

Errors are recorded as Diagnostic Logs 272–274.

1. Check no items are placed in a position to block the infrared beam, e.g. paper fallen between the column and the bellows housing.
2. Clean the bellows housing and the window on the bellows position sensor.
3. Check that the bellows position sensor is mounted in correct position (level).

4. Redo the PuC. If the test still fails, continue with Step 5.
5. Check function of the bellows position sensor:
   - Make sure that the breathing bellows is in its lower position.
   - Connect a voltmeter between connector P46 / Pin C9 on PC 1750 Transducer and GND.
   - Set KION / KION-i to Standby.
   - Check that the voltmeter reads +5 V.
   - Cover the bellows position sensor ”window” with a piece of white paper.
   - Check that the voltmeter reads 0 V.
   - Shifting between +5V and 0V indicates that the sensor is OK and that the fault is located to PC 1750. Check and replace if necessary.
   - If voltage does not shift, check and if necessary replace:
     – PC 1766 Bellows position sensor
     – Patient unit cable connecting PC 1766 with PC 1733 / PC 1796.
6. Redo the PuC after each checked / replaced part. If the test still fails, report to EM-HSC.

Checking mushroom valves-test fails

During this sequence of the PuC the proper function of the mushroom valves is checked.

Errors are recorded as Diagnostic Logs 275–277.

1. Check that the mushroom valves and the patient cassette support plate are clean.
2. Check that the valve assembly plate is correctly mounted on the patient cassette.
3. Check that the mushroom valves are undamaged and correctly mounted on the valve assembly plate.
4. Check that the mushroom valves MV1–5 and the corresponding electromagnetic valves EMV1–5 work properly. Hold a valve assembly plate in correct position on the support plate and run the ventilator with the settings described in the table below.

Setting	MV1	MV2	MV3	MV4	MV5
Circle System / Manual Vent.	–	O	O	–	O
Circle System / Volume Contr.	O	O	–	–	O
Non-Rebreathing / Manual Vent.	O	X	O	O	O
Non-Rebreathing / Volume Contr.	O	–	O	O	–

O = Inflated **–** = Deflated **X** = Switching

5. Check the Mushroom valve control gas supply pressure (20 kPa delivered by REG 1). For adjustment of REG 1, refer to the tool “Pressure Tester 0.2 bar regulator”, P/N 65 62 479.
6. Check adjustment of the patient cassette support plate with aid of the “Support plate adjustment tool”, P/N 66 37 529. This measuring gauge is needed for proper adjustment of the patient cassette support plate in order to minimize leakage between patient cassette and patient unit.
7. Redo the PuC after each action. If the test still fails, report to EM-HSC.

Checking alarm detectors-test fails

A check that the alarm detectors works properly is made during this sequence of the PuC.

Errors are recorded as Diagnostic Log 278.

1. Check for obstructions in the EVAC system.
2. Replace the “Upper Press. Limit” potentiometer.
3. Replace PC 1737 Measuring.
4. Replace complete PC 1750 Transducer (old version) or the INSP PC 1781 Pressure transducer (new version).
5. Redo the PuC after each action. If the test still fails, report to EM-HSC.

Other errors and remedies

Symptoms of errors	Possible causes	Remedy
Discrepancies in set and measured values in Tidal Volume/ Minute Volume	Drifting flow transducer.	Perform PuC.
Too large Exp. tidal volumes in Volume Control / Circle System. The Exp. tidal volumes are within limits in Non-Rebreathing.	Poor diaphragms in the Gas Module Drive gas.	Replace diaphragm in the Gas Module Drive gas.
Incorrect gas concentrations.	Poor diaphragms in the Gas Module AIR (N2O) or Gas Module O2.	O2 concentration too high: • Replace diaphragm in the Gas Module O2. O2 concentration too low: • Replace diaphragm in the Gas Module AIR (N2O).
The KION / KION-i will not start – Alarm indicator lamp on the control panel is flashing.	Power On Reset (POR) inhibits the microprocessor functions.	• Check cables and cable connectors. • Check that the software in the different subsystem are compatible with each other. • Replace PC 1730 Control includings its CON-SW or update the CON-SW. • Replace PC 1737 Measuring and/or the MEA-PROM. • Replace PC 1672 Control Panel and/or the PAN-PROM.
At start-up of the KION / KION-i: Constant alarm, all LEDs are lit.	Poor contact at the ALA-PROM.	Check the contact pins on the ALA-PROM and in the PROM socket.
The KION / KION-i will only run in battery mode.	The AC/DC Converter will not supply power to the Power & Communication Interface.	• Check cables and cable connectors. • Check/replace the fuses in the AC/DC Converter. • Replace the AC/DC Converter.
The KION / KION-i will not run in battery mode.	The Internal battery will not supply power to the Power & Communication Interface.	• Check cables and cable connectors. • Check Internal battery. • Check the fuses F1 and F2 on PC 1675 Power Supply

Symptoms of errors	Possible causes	Remedy
The measured "Exp. Minute vol." value is not stabile.	1. Leakage at the uni-directional valves.	1. Replace the uni-directional valves.
	2. Failure in the expiratory flow transducer.	2. Clean/replace the expiratory flow transducer.
	3. Poor contact between the expiratory flow transducer and the connector in the docking station.	3a. Replace the expiratory flow transducer. 3b. Replace the contact in the docking station.
	4. Failure in the fresh gas flow transducer. This failure can be indicated as a big difference between the set "Minute Volume" and the measured "Exp. Minute vol.".	4. Replace the fresh gas flow transducer.
	5. Failure in the gas modules.	5. Replace the gas modules, one at the time.
Leakage in the Luer-lock connections for the pressure transducer tubes (on PC 1750 TRANSDUCER).	The threads in the plastic Luer-lock connector is damaged.	Replace the plastic Luer-lock connector.
Software not responding due to poor electric contact:		
1. All control panel displays for measured values are black.	1. Poor contact at the MEA-PROM.	1. Check the contact pins on the MEA-PROM and in the PROM socket.
2. All control panel displays are black.	2. Poor contact at the ALA-PROM or at the PAN-PROM.	2. Check the contact pins on the ALA-PROM or on the PAN-PROM and in the PROM sockets.
3. The control panel lights up only during the start-up sequence or the control panel displays for set values are black.	3. Poor contact at the connector for the PC 1730 CONTROL.	3. Check the connection of the PC 1730 CONTROL.

Diagnostic logs

General

Data regarding events and performance related to the KION / KION-i workstation is captured and stored in the log list. This chapter will mainly handle the two log types intended for field service troubleshooting.

These two diagnostic log types are:

- The monitor **Diagnostic Log**.
  - The Diagnostic Log is stored in the KION Monitor.
  - The Diagnostic Log description is written in decimal numbers. It contains log number and source number.
  - The Diagnostic Log is identified by the text "CANbus Diag" in the Description-field.

  Note: The PICK AND GO concept allows a KION Monitor to be moved between different KION workstations. The Diagnostic Log, stored in the KION Monitor, may thus contain logs from different KION workstations.
- The communication interface **CPS/IDS Diagnostic Log**.
  - The CPS/IDS Diagnostic Log is stored in the Communication Interface (CPS or IDS).
  - The CPS/IDS Diagnostic Log description is written in hexadecimal numbers. It contains log number and, for some logs, subdata useful during troubleshooting.
  - The CPS/IDS Diagnostic Log is identified by the text "CAN DATA (HEX)" in the Description-field.

The logs can be shown on the KION Monitor or downloaded to a PC. A print-out of the logs is possible if a printer is connected to the KION / KION-i workstation. Downloading and printing is described in chapter "Service procedures".

Do not delete the diagnostic logs, e.g. after performed service. In case of future troubleshooting on the workstation, as much relevant log information as possible should be kept. The oldest logs will automatically be overwritten when the log list is full.

Date and Time used by the KION/KION-i workstation will be supplied by the connected KION Monitor. To assure that correct information is stamped on the logs, check the Date and Time setting on the KION Monitor. Adjust if required.

If no KION Monitor is connected to the KION workstation or if communication is not established (e.g. during startup), the Time and Date stamp in the CPS/IDS Diagnostic Log will be 12:00 1/1/93.

Log source

The table below refers the source # (subunit) of the logs as stated in the monitor Diagnostic log:

Log #	Subunit	Source #
1-99	ALA – Alarm	0
100-299	CON – Control	1
300-399	PAN – Panel	3
400-499	MEA – Measuring	4
600-699	MGI – Multigas analyzer interface	6

Reading hexadecimal numbers

To convert hexadecimal numbers into decimal numbers, it is recommended to use a calculator that handles hexadecimals. Such Calculator is included as an Utility in Windows. Set the Calculator in Scientific mode to access the hexadecimal converter.

Report to EM-HSC

If the troubleshooting information in the Diagnostic Log table below will not identify the problem, report to EM-HSC for further investigations.

When reporting to EM-HSC, the following information must be enclosed:

- Serial number of the KION / KION-i workstation.
- Version number of the KION / KION-i workstation (e.g. version 7.x).
- All sub-units SW versions (CON, MEA, etc). Refer to the Component log.
- Copy of the Diagnostic Log and the CPS/IDS Diag. Log.

Always note with date and time when the event occurred. If wrong Date and Time is set on the Monitor, this will make the Date- and Time-stamp in the logs incorrect. Always consider such deviation when analyzing the logs. Also inform about Date- and Time-deviation if the logs are sent to EM-HSC for troubleshooting support.

Logs displayed on the KION Monitor

Diagnostic log

To display the Diagnostic Log on the KION Monitor, select:

Menu / Monitor Setup / Biomed / Logs / Diagnostic Log

An example of a Diagnostic Log, as shown on the KION Monitor, can be found in the illustration below.

CPS/IDS Diagnostic Log

To display the CPS/IDS Diagnostic Log on the KION Monitor, select:

Menu / Monitor Setup / Biomed / Logs / CPS/IDS Diag. Log

An example of a CPS/IDS Diagnostic Log, as shown on the KION Monitor, can be found in the illustration below.

Log content

The events are displayed in order Newest to Oldest. The following information is shown in the logs:

- Total Number Of Diagnostic Events: Number of diagnostic events in the memory.
- SW Version:
  - Diagnostic Log: Software version installed in the KION Monitor.
  - CPS/IDS Diagnostic Log: Software version installed in the CPS / IDS.
- Product Serial #:
  - Diagnostic Log: KION Monitor serial number.
  - CPS/IDS Diagnostic Log: CPS/IDS serial number.
- Diagnostic Number: Can be used to identify some multigas analyzer logs.
- Class: Not intended for service purpose.
- Time: Time stamp (h:min) of the event.
- Date: Date stamp (month/day/year) of the event.
- Dup Cnt: Counts if a log is repeted several times within a short time frame without interruption of other logs. Only the first event is time stamped and shown. The repeted logs will only enumerate this Dup Cnt. Example: Dup Cnt 6 shows that this log has been repeted 6 times after the first event, i.e. there is a total number of 7 logs.
  Note: Dup Cnt is used only in the Diagnostic Log. In the CPS/IDS Diagnostic Log, also repeted logs are shown and time stamped.
- Line #: Not intended for service purpose.
- Description:
  - Diagnostic Log: Log description written in decimal numbers.
  - CPS/IDS Diagnostic Log: Log description written in hexadecimal numbers containing:
    - Log number. 4 characters to be found directly after the hex-number 55.
    - Sub data. All 10 characters to be found directly after the Log number. In most of the logs, only the 4 last subdata characters are used. Only logs 120 and 185 uses all 10 characters.

Log storage capacity

SC 7000 / 9000XL: ..... 25 events

SC 9000: ..... 100 events

CPS / IDS: ..... 100 events

Diagnostic Log

Total Number Of Diagnostic Events:	197		Product Serial #: 5390111370
SW Version:	VF3.0-W		

Events Are Displayed Newest To Oldest

Diagnostic Number	Class	Time	Date	Dup Cnt	Line #	Description
0x8038b03d	SW-WRN	16:37	4/18/03	0	5019	KION CRITICAL FAIL (100) Source (0)
0x8038b037	SW-WRN	16:37	4/18/03	1	11070	CANbus Diag (27) Source (0)
0x8038b03e	SW-WRN	16:37	4/18/03	0	11070	CANbus Diag (27) Source (0)
0x8038b037	SW-WRN	16:35	4/18/03	0	11063	CANbus Diag (105) Source (1)
0x8038b037	SW-WRN	16:20	4/18/03	0	11070	MultiGas failure (560) Source (6)
0x8038b03e	SW-WRN	16:20	4/18/03	0	11070	CANbus Diag (601) Source (6)
0x8038b03e	SW-WRN	16:19	4/18/03	0	11063	CANbus Diag (613) Source (6)
0x8038b037	SW-WRN	16:18	4/18/03	0	11063	CANbus Diag (407) Source (4)
0x8038b03d	SW-WRN	16:17	4/18/03	0	5019	KION CRITICAL FAIL (100) Source (4)
0x8038b03d	SW-WRN	16:17	4/18/03	0	11070	CANbus Diag (421) Source (4)
0x8038b03d	SW-WRN	16:15	4/18/03	0	5019	KION CRITICAL FAIL (100) Source (1)
0x8038b03e	SW-WRN	16:15	4/18/03	0	11063	CANbus Diag (204) Source (1)

Diagnostic Log example

CPS/IDS Diagnostic Log

Total Number Of Diagnostic Events:	15596		Product Serial #: 3920010476
SW Version:	VF0		

Events Are Displayed Newest To Oldest

Diagnostic Number	Class	Time	Date	Dup Cnt	Line #	Description
0x8038b03d	WRN	16:37	4/18/03	0	5019	CAN DATA (HEX): 9463 55 001B CF 00 6C 02 00
0x8038b037	WRN	16:37	4/18/03	0	11070	CAN DATA (HEX): 9463 55 001B CF 00 6C 02 00
0x8038b03e	WRN	16:37	4/18/03	0	11070	CAN DATA (HEX): 9463 55 001B CF 00 6C 02 00
0x8038b037	WRN	16:35	4/18/03	0	11063	CAN DATA (HEX): 9463 55 0069 03 00 CC 02 01
0x8038b037	WRN	16:20	4/18/03	0	11070	CAN DATA (HEX): 9463 55 0259 00 A5 6C 01 02
0x8038b03e	WRN	16:20	4/18/03	0	11070	CAN DATA (HEX): 9463 55 0259 00 A5 6C 01 02
0x8038b03e	WRN	16:19	4/18/03	0	11063	CAN DATA (HEX): 9463 55 0265 03 35 A5 00 55
0x8038b037	WRN	16:18	4/18/03	0	11063	CAN DATA (HEX): 9463 55 0197 D4 01 02 00 00
0x8038b03d	WRN	16:17	4/18/03	0	5019	CAN DATA (HEX): 9463 55 01A5 03 35 A5 00 55
0x8038b03d	WRN	16:17	4/18/03	0	11070	CAN DATA (HEX): 9463 55 01A5 03 35 A5 00 55
0x8038b03d	WRN	16:15	4/18/03	0	5019	CAN DATA (HEX): 9463 55 00CC 03 35 A5 02 9B
0x8038b03e	WRN	16:15	4/18/03	0	11063	CAN DATA (HEX): 9463 55 00CC 03 35 A5 02 9B

Log number Subdata

CPS/IDS Diagnostic Log example

6

```
Enter Selection: 1
Main Diagnostic Log                    Processor Type : mi860
Log Format : M1.4                      Serial Number : XXXXXXXXXX
Diagnostic Log Size : 25               Product ID : APOLLO
Total Events Logged : 3353, BUFFER OVERFLOW  Software Version : am_yf1_c.80
Entries to display : 1 - 25            Initialization Pattern : ERRR
Date of Report : 10/28/02  15:41:18    Elapsed Time (hour:min:sec):    7:55: 7

        >>> EVENTS DISPLAYED OLDEST TO NEWEST <<<

Sequence  Entry   Event     Event              Dup  Fail  Date      Time      OS Time
    #       #       ID      Class              Cnt  State                     (10 msec)
-------------------------------------------------------------------------------------
   120      5   8038b03eH  WARNING             2     0  10/25/02  09:56:02    851798
     FILENAME = $RCSfile: amgm_canbus.c,v $ $Revision: 1.158 $  LINE NUMBER = 11819
     DESCRIPTION: CANbus Diag (229) Source (1)
     SOFTWARE VERSION: am_yf1_c.80
-------------------------------------------------------------------------------------
   114      6   8038b037H  WARNING             0     0  10/25/02  09:56:04    851986
     FILENAME = $RCSfile: amgm_canbus.c,v $ $Revision: 1.158 $  LINE NUMBER = 11827
     DESCRIPTION: CANbus Diag (202) Source (1)
     SOFTWARE VERSION: am_yf1_c.80
-------------------------------------------------------------------------------------
```

Diagnostic Log example

```
Enter Selection: 1
Main Diagnostic Log                    Processor Type : 68040
Log Format : M1.4                      Serial Number : N/A
Diagnostic Log Size : 100              Product ID : HERCULES
Total Events Logged : 16908, BUFFER OVERFLOW  Software Version : N/A
Entries to display : 1 - 100           Initialization Pattern : ERRR
Date of Report : 01/09/03  11:38:51

        >>> EVENTS DISPLAYED OLDEST TO NEWEST <<<

Sequence  Entry   Event     Event              Dup  Fail  Date      Time      OS Time
    #       #       ID      Class              Cnt  State                     (10 msec)
-------------------------------------------------------------------------------------
 16809      1   80367007H  WARNING             0     0  12/20/02  11:53:14   1661237
     FILENAME = $RCSfile: can.c,v $ $Revision: 1.13 $  LINE NUMBER = 371
     DESCRIPTION: CAN DATA (HEX): 9428 55 00E5 4E 03 58 01 12
     SOFTWARE VERSION: oc_yf1_b.7
-------------------------------------------------------------------------------------
 16810      2   80367008H  WARNING             0     0  12/20/02  11:59:39   1699809
     FILENAME = $RCSfile: can.c,v $ $Revision: 1.13 $  LINE NUMBER = 371
     DESCRIPTION: CAN DATA (HEX): 9428 55 00E5 4E 03 86 01 14
     SOFTWARE VERSION: oc_yf1_b.7
-------------------------------------------------------------------------------------
```

Log number

Sub-data

CPS/IDS Diagnostic Log example

Downloaded and printed logs

The Diagnostic Log and the CPS/IDS Diagnostic Log can be downloaded to a PC or printed on a laser printer. The procedures for downloading and printing is described in chapter “Service procedures”.

Example of downloaded or printed Diagnostic Log and CPS/IDS Diagnostic Log can be found in the adjacent illustrations.

Log content

The events are displayed in order Oldest to Newest. The following information is shown in the logs:

- Sequence #: Not intended for service purpose.
- Entry #: Not intended for service purpose.
- Event ID: Can be used to identify some multigas analyzer logs.
- Event Class: Not intended for service purpose.
- Dup Cnt: Counts if a log is repeted several times within a short time frame without interruption of other logs. See further information regarding the ”Dup Cnt” on page 20.
- Fail state: Not intended for service purpose.
- Date: Date stamp (month/day/year) of the event.
- Time: Time stamp (h:min) of the event.
- OS Time from startup (in 1/100 s):
  - Diagnostic Log: Time from monitor startup.
  - CPS/IDS Diagnostic Log: Time from KION startup.
- Filename: Not intended for service purpose.
- Line Number: Not intended for service purpose.
- Description:
  - Diagnostic Log: The log description written in decimal numbers.
  - CPS/IDS Diagnostic Log: Log description written in hexadecimal numbers containing:
    - Log number. 4 characters to be found directly after the hex-number 55.
    - Sub data. All 10 characters to be found directly after the Log number. In most of the logs, only the 4 last subdata characters are used. Only logs 120 and 185 uses all 10 characters.
- Software Version:
  - Diagnostic Log: Software version installed in the KION Monitor.
  - CPS/IDS Diagnostic Log: Software version installed in the CPS / IDS.

Diagnostic log groups

The diagnostic logs can be divided into four main groups:

1. Technical Alarm logs.
2. Pre-use check logs.
3. Calibration logs.
4. Other diagnostic logs.

All logs are listed in the "Diagnostic Log table" below in this chapter.

Technical Alarm logs

In the Diagnostic Log-example shown on page 21, the two logs (27) with identical Time and Date stamp indicates that "MEA is not responding".
The corresponding logs in the CPS/IDS Diagnostic Log-example are ...001B....

If a Technical Alarm occurs, the first recommended remedy is to power-cycle the KION / KION-i workstation.

Together with the Technical alarm logs, there are some "Additional logs" created, see below. These Additional logs are shown in combination with the Technical alarm logs. In the Diagnostic Log-example shown on page 21, the two logs (27) are combined with the Additional log "KION CRITICAL FAIL (100) Source (0)" with identical Time and Date stamp

Pre-use check logs

Logs that indicates errors and events during the Pre-use Check.

Calibration logs:

Logs that indicates errors and events during the Calibration.

Other diagnostics:

Logs that indicates errors and events during startup and operation of the KION / KION-i workstation.

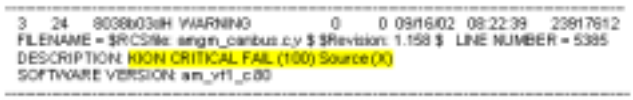
Additional logs

Together with the Technical alarm logs, there are some additional logs created. These additional logs are always shown in combination with the Technical alarm logs.

The additional logs are only shown in the Diagnostic Log, not in the CPS/IDS Diagnostic Log.

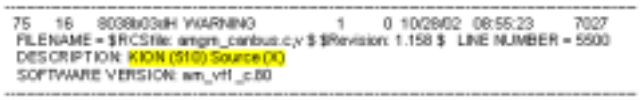
The additional logs are:

KION CRITICAL FAIL (100)


3 24 8038b03dH WARNING 0 0 09/16/02 08:22:39 23917612
FILENAME = $RCSfile: amgm_canbus.c,v $ $Revision: 1.158 $ LINE NUMBER = 5395
DESCRIPTION: KION CRITICAL FAIL (100) Source (X)
SOFTWARE VERSION: am_vf1_c.80

Technical Alarm followed by one or several clarifying diagnostic messages.

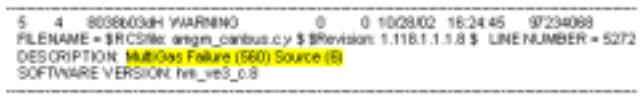
KION (510)


75 16 8038b03dH WARNING 1 0 10/28/02 08:55:23 7027
FILENAME = $RCSfile: amgm_canbus.c,v $ $Revision: 1.158 $ LINE NUMBER = 5500
DESCRIPTION: KION (510) Source (X)
SOFTWARE VERSION: am_vf1_c.80

Technical Voltage Alarm from ALA followed by one of the clarifying diagnostic messages:

- 026 – ALA: DIAG_VOLTAGE_ERROR_24V_ON
- 042 – ALA: DIAG_VOLTAGE_ERROR_PLUS_15V_ON
- 043 – ALA: DIAG_VOLTAGE_ERROR_MINUS_15V_ON

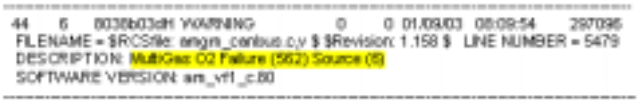
MultiGas Failure (560)


5 4 8038b03dH WARNING 0 0 10/28/02 16:24:45 97234068
FILENAME = $RCSfile: amgm_canbus.c,v $ $Revision: 1.118.1.1.1.8 $ LINE NUMBER = 5272
DESCRIPTION: MultiGas Failure (560) Source (6)
SOFTWARE VERSION: hm_ve3_c.8

Technical HW Alarm from the CAN/RS232 interface followed by one of the clarifying diagnostic messages:

- 601 – MGI: DIAG_CPU_ERROR
- 602 – MGI: DIAG_ROM_ERROR
- 603 – MGI: DIAG_RAM_ERROR
- 611 – MGI: DIAG_TIMER_ERROR
- 612 – MGI: DIAG_WD_ERROR

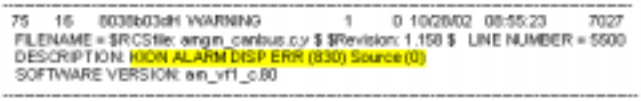
MultiGas O2 Failure (562)


44 6 8038b03dH WARNING 0 0 01/09/03 08:09:54 297095
FILENAME = $RCSfile: amgm_canbus.c,v $ $Revision: 1.158 $ LINE NUMBER = 5479
DESCRIPTION: MultiGas O2 Failure (562) Source (6)
SOFTWARE VERSION: am_vf1_c.80

Technical O2 module Alarm from the CAN/RS232 interface followed by the clarifying diagnostic message:

- 605 – MGI: O2_MODULE_ERROR

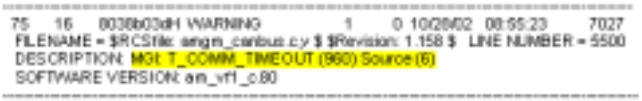
KION ALARM DISP ERR (830)


75 16 8038b03dH WARNING 1 0 10/28/02 08:55:23 7027
FILENAME = $RCSfile: amgm_canbus.c,v $ $Revision: 1.158 $ LINE NUMBER = 5500
DESCRIPTION: KION ALARM DISP ERR (830) Source (0)
SOFTWARE VERSION: am_vf1_c.80

Technical Display Alarm from ALA followed by one of the clarifying diagnostic message:

- 032 – ALA: DIAG_ALARM_BUZZER_ERROR
- 033 – ALA: DIAG_STARTUP_LED_TEST_FAILED
- 049 – ALA: DIAG_ERROR_LINE_ERROR

MGI: T_COMM_TIMEOUT (960)


75 16 8038b03dH WARNING 1 0 10/28/02 08:55:23 7027
FILENAME = $RCSfile: amgm_canbus.c,v $ $Revision: 1.158 $ LINE NUMBER = 5500
DESCRIPTION: MGI: T_COMM_TIMEOUT (960) Source (6)
SOFTWARE VERSION: am_vf1_c.80

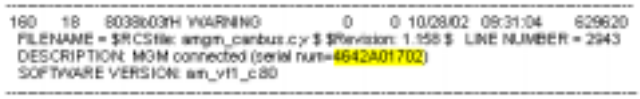
Technical Communication Alarm from the CAN/ RS232 interface followed by one of the clarifying diagnostic messages:

- 606 – MGI: DIAG_COMMAND_TIMEOUT_ERROR
- 608 – MGI: DIAG_STATUS_TIMEOUT_ERROR

Multigas analyzer logs

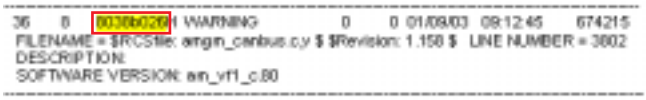
Multigas analyzer serial number

Each time the power switch is turned from Off to Standby or On, a Diagnostic Log including serial number of the built-in multigas analyzer is created. If the multigas analyzer serial number written in the log vary between different start-up occations, this indicates that the multigas analyzer has been replaced. However, it may also indicate that the KION Monitor has been moved between different KION workstations and thus been connected to different multigas analyzers.


160 18 8038b03fH WARNING 0 0 10/28/02 09:31:04 629620
FILENAME = $RCSfile: amgm_canbus.c,v $ $Revision: 1.158 $ LINE NUMBER = 2943
DESCRIPTION: MGM connected (serial num=4642A01702)
SOFTWARE VERSION: am_vf1_c.80

Multigas analyzer information in the logs

Some logs without text in the Description-field can be identified as multigas analyzer error logs by the information written in the Diagnostic number- / Event ID-field.


36 0 8038b026H WARNING 0 0 01/09/03 09:12:45 674215
FILENAME = $RCSfile: amgm_canbus.c,v $ $Revision: 1.158 $ LINE NUMBER = 3802
DESCRIPTION:
SOFTWARE VERSION: am_vf1_c.80

The table below shows the Diagnostic numbers / Event IDs related to multigas analyzer errors.

8038b016	MGM Status: Persistent Pressure Data Invalid
8038b01d	MGM Status: Self Test Error
8038b01f	MGM Status: IR Signal Degraded
8038b020	MGM Status: 4710 Operation Fault
8038b021	MGM Status: 4710 Data Accuracy Not Guaranteed
8038b022	MGM Status: 4710 Data Not Available
8038b023	MGM Status: Check 4710 Head
8038b024	MGM Status: 4750 System Fault
8038b025	MGM Status: 4750 Agent ID Module Operation Fault
8038b026	MGM Status: 4750 Agent ID Module Accuracy Not Guaranteed
8038b027	MGM Status: 4750 Agent ID Module Data Not Available
8038b029	MGM Status:Power Error
8038b01e	4710 Operation Fault + Set Synch Error
80367001	CAN_HW_Overun
8038b006	Cannot select MGM agent 12857. Action: Upgrade to VF2.3 or later.

For qualified troubleshooting of the multigas analyzers, always use the recommended service software tools (available on the Intranet).

In case of multigas analyzer errors, always check that KION Monitor-SW and CPS/IDS-SW according to applicable Release Notes are installed.

Diagnostic log table

Technical alarm logs	Pre-use check logs	Calibration logs	Other logs	Diagnostic Log #	CPS/IDS Diag. Log #	Cause	Remedy
x 100				001	... 00 01 ...	ALA: DIAG_STARTUP_CPU_TEST_FAILED	**Fault:** Hardware failure. **Description:** CPU is not working during startup hardware test. Technical alarm is generated. **What to do**: Replace PC 1672 Control Panel.
x 100				002	... 00 02 ...	ALA: DIAG_STARTUP_RAM_TEST_FAILED	**Fault:** Hardware failure. **Description:** ROM is not working during startup hardware test. Technical alarm is generated. **What to do**: Replace PC 1672 Control Panel.
x 100				003	... 00 03 ...	ALA: DIAG_STARTUP_ROM_TEST_FAILED	**Fault:** Hardware failure. **Description:** RAM is not working during startup hardware test. Technical alarm is generated. **What to do**: Replace PC 1672 Control Panel.
x 100				004	... 00 04 ...	ALA: DIAG_5_VOLTAGE_TEST_ERROR	**Fault:** Voltage monitoring error +5V (Hardware failure). **Description:** The check to simulate false voltage levels for +5V failed during the startup hardware voltage test. Technical alarm is generated. **What to do**: Replace PC 1672 Control Panel.
x 100				005	... 00 05 ...	ALA: DIAG_15_VOLTAGE_TEST_ERROR	**Fault:** Voltage monitoring error +/-15V (Hardware failure). **Description:** The check to simulate false voltage levels for +/-15V failed during the startup hardware voltage test. Technical alarm is generated. **What to do**: Replace PC 1672 Control Panel.
x 100				006	... 00 06 ...	ALA: DIAG_AD_CONVERTER_ERROR	**Fault:** A/D converter hardware failure. **Description:** The startup hardware voltage test or the continuous battery monitoring could not be completed due to A/D converter error. Technical alarm is generated. **What to do**: Replace PC 1672 Control Panel.

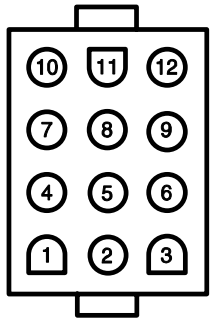
x 100				007	... 00 07 ...	ALA: DIAG_24_VOLTAGE_TEST_ERROR	**Fault:** Voltage monitoring error +24V (Hardware failure). **Description:** The startup hardware voltage test or the continuous battery monitoring failed because the +24 voltage is not within the range for battery voltage, i.e. [abs(meas_24 - batt_voltage) > 0.5 V]. Technical alarm is generated. **What to do**: 1. Replace PC 1672 Control Panel 2. Replace PC 1675 Power supply 3. Check the Control panel cable.
x 100				008	... 00 08 ...	ALA: DIAG_DISABLE_VALVES_ERROR	**Fault:** Disable valve error (Hardware failure). **Description:** The check if it is possible to disable valves failed during the startup hardware voltage test. Technical alarm is generated. If the valves already are disabled (+24V_VALVE_L is high) before the test, or if the signal +24V_VALVE_L is not going high when the signal 15V_ERR_L is set low, then this diagnostic is written. **What to do**: 1. Replace PC 1750 Transducer (or INSP/EXP pressure transducer) 2. Replace PC 1675 Power Supply. 3. Replace PC 1672 Control Panel.
			x	009	... 00 09 ...	ALA: DIAG_CAN_BUFFER_FULL	**Fault:** Communication bus (CAN) is not working. **Description:** The circular CAN receive buffer is full. At least one CAN-message is missed. Circular buffer holds 10 CAN-messages. **What to do:** 1. If this log is repeted several times; check CAN communicating units, i.e. microprocessor controlled PC boards, multigas analyzer, KION Monitor and DuoView. Also check PC board- and cable connectors. 2. Report to EM-HSC.
			x	010	... 00 0A ...	ALA: DIAG_CAN_DATA_OVERRUN	**Fault:** Communication bus (CAN) is not working . **Description:** Data overrun has occurred. At least one CAN-message is missed. **What to do**: 1. If this log is repeted several times; check CAN communicating units, i.e. microprocessor controlled PC boards, multigas analyzer, KION Monitor and DuoView. Also check PC board- and cable connectors. 2. Report to EM-HSC.
x 100				011	... 00 0B ...	ALA: DIAG_EMERGENCY_TEST_MEASURE	**Fault:** Hardware failure. **Description:** ALA orders MEA to pull emergency line. The startup hardware emergency line test failed. Technical alarm is generated. **What to do**: 1. Check that the MEA-PROM is correctly mounted 2. Replace PC 1737 Measuring.

x 100				012	... 00 0C ...	ALA: DIAG_EMERGENCY_TEST_CONTROL	**Fault:** Hardware failure. **Description:** ALA orders CON to pull emergency line. The startup hardware emergency line test failed. Technical alarm is generated. **What to do**: Replace PC 1730 Control.
x 100				013	... 00 0D ...	ALA: DIAG_EMERGENCY_TEST_PANEL	**Fault:** Hardware failure. **Description:** ALA orders PAN to pull emergency line. The startup hardware emergency line test failed. Technical alarm is generated. **What to do**: 1. Check that the PAN-PROM is correctly mounted 2. Replace PC 1672 Control Panel.
x 100				015	... 00 0F ...	ALA: DIAG_EMERGENCY_LINE_ACTIVE_ERROR	**Fault:** Hardware failure. **Description:** The startup hardware test failed because the emergency line was already active before the emergency line-, sound- or the voltage test. Technical alarm is generated. **What to do**: 1. Check if the faulty PC board can be identified by another adjacent diagnostic log 2. Replace PC 1737 Measuring 3. Replace PC 1730 Control 4. Replace PC 1672 Control Panel.
			x	016	... 00 10 ...	ALA: DIAG_CAN_SEND_TIMEOUT	**Fault:** Communication bus (CAN) is not working. **Description:** The CAN driver reports an Timeout error. **What to do**: 1. Replace PC 1672 Control Panel. 2. If this log is repeted several times; check CAN communicating units, i.e. microprocessor controlled PC boards, multigas analyzer, KION Monitor and DuoView. Also check PC board- and cable connectors. 3. Report to EM-HSC.
			x	020	... 00 14 ...	ALA: DIAG_TECH_ERR_BUFF_OVERFLOW	**Fault:** Technical Error Buffer Overflow. **Description:** There is no room for this alarm in buffer. **What to do**: Report to EM-HSC.
			x	021	... 00 15 ...	ALA: DIAG_LOW_BATTERY_CAPACITY_ DURING_BATTERY_TEST	**Fault:** Battery capacity is low. **Description:** Low battery capacity during internal battery test. **What to do**: Replace internal battery.
			x	023	... 00 17 ...	ALA: DIAG_INTERNAL_ERROR	**Fault:** Internal program error. **Description:** For debugging purpose. **What to do**: Report to EM-HSC.

			x	024	... 00 18 ...	ALA: DIAG_LOW_BATTERY_CAPACITY	**Fault:** Low Battery Capacity. **Description:** Low Battery Capacity detected at startup. **What to do**: 1. Allow the batteries to charge during 6 hours. 2. Check / replace internal batteries.
			x	025	... 00 19 ...	ALA: DIAG_NOT_POSSIBLE_TO_LOAD_FULLY	**Fault:** Internal batteries not possible to charge fully. **Description:** The 24 V-voltage does not increases after 1 hour charge or is overcharged during more than 2.5 hours. **What to do**: Replace internal batteries.
x 510			x	026	... 00 1A ...	ALA: DIAG_VOLTAGE_ERROR_24V_ON	**Fault:** Failure on the +24 voltage. **Description:** The supervision of the +24 voltage indicates an error. Alarm 510 is generated. **What to do**: Check if +24V_PTC is available at P59 on PC 1675 Power Supply: • If +24V_PTC is not available, replace the AC/DC Converter. Note: As the two fans inside the battery drawer runs on +24 V, this error is easy to identify by checking the function of these fans. • If +24V_PTC is available, this voltage is correctly generated by the Power Supply system. The error must be found on PC 1672 Control Panel or in the cables/connectors.
x 100				027	... 00 1B ...	ALA: DIAG_MEASURE_NOT_RESPONDING	**Fault:** MEA is not responding **Description:** No STATUS_REPLY is received from this node on the STATUS_REQUEST message within 3.3 seconds. Technical alarm is generated. **What to do**: 1. Check that the MEA-PROM is correctly mounted 2. Replace PC 1737 Measuring 3. Replace PC 1672 Control Panel. If all diagnostics 027,028,029 are shown in log, this is probably the first alternative.
x 100				028	... 00 1C ...	ALA: DIAG_CONTROL_NOT_RESPONDING	**Fault:** CON is not responding. **Description:** No STATUS_REPLY is received from this node on the STATUS_REQUEST message within 3.3 seconds. Technical alarm is generated. **What to do**: 1. Replace PC 1730 Control 2. Replace PC 1672 Control Panel. If all diagnostics 027,028,029 are shown in log, this is probably the first solution.

x 100				029	... 00 1D ...	ALA: DIAG_PANEL_NOT_RESPONDING	**Fault:** PAN is not responding. **Description:** No STATUS_REPLY is received from this node on the STATUS_REQUEST message within 3.3 seconds. Technical alarm is generated. **What to do**: 1. Check that the PAN-PROM is correctly mounted 2. Replace PC 1672 Control Panel. If all diagnostics 027,028,029 is shown in log. this is probably the first solution.
x 100				031	... 00 1F ...	ALA: DIAG_STARTUP_WATCHDOG_TEST_FAILED	**Fault:** Hardware failure. **Description:** Watchdog is not working during the startup hardware test. Technical alarm is generated. **What to do**: Replace PC 1672 Control Panel.
x 100 830				032	... 00 20 ...	ALA: DIAG_ALARM_BUZZER_ERROR	**Fault:** Hardware failure during the startup test of sound generation and error line. **Description:** The first part of the test checks that Sound Sense is activated by the Alarm Buzzer within 40 ms and deactivated within 100 ms. The second part of the test lets the emergency line activate/deactivate the buzzer by checking that Sound Sense is activated/deactivated. If not, this diagnostic and DIAG_ERROR_LINE_ERROR (049) is written. Technical alarm and alarm 830 is generated. **What to do**: If the log is repeted; replace PC 1672 Control Panel.
x 830			x	033	... 00 21 ...	ALA: DIAG_STARTUP_LED_TEST_FAILED	**Fault:** Hardware failure. **Description:** The alarm LED is not working during startup hardware test. Alarm 830 is generated. **What to do**: Replace PC 1672 Control Panel
x 100				034	... 00 22 ...	ALA: DIAG_POWER_BACKUP_FAILURE	**Fault:** Hardware failure. **Description:** Checks if the Backup Capacitor for +5V failed during startup hardware test. Technical alarm is generated. **What to do**: Replace PC 1672 Control Panel
			x	035	... 00 23 ...	ALA: DIAG_ALARM_SUBSYSTEM_RESET_ERROR	**Fault:** Hardware failure. **Description:** The +5 V is pulled below the reset limit to trig a power-on reset during startup hardware test, but the reset is detected. **What to do**: Replace PC 1672 Control Panel.
			x	036	... 00 24 ...	ALA: DIAG_SILENCE_BUTTON_STUCK	**Fault:** Hardware failure. **Description:** The Alarm Silence button is stuck for more than 20 seconds. **What to do**: Check / replace Alarm Silence button.
x 100				037	... 00 25 ...	ALA: DIAG_STARTUP_TIMER_TEST_FAILED	**Fault:** Hardware failure. **Description:** Timer is not working during startup hardware test. Technical alarm is generated. **What to do**: Replace PC 1672 Control Panel

x 100				038	... 00 26 ...	ALA: DIAG_MEASURE_NOT_FULLY_OPERATIONAL	**Fault:** MEA is not in the same state as ALA. **Description:** MEA is in Standby when ALA is in On (or vice versa) for more than 3.3 seconds. Technical alarm is generated. **What to do**: 1. Check if the Power switch is faulty and stuck between its fixed positions. If the switch is sluggish, adjust the knob. If all diagnostics 038, 039, 040 are shown in the log, this is a possible fault. 2. Check that the MEA-PROM is correctly mounted 3. Replace PC 1737 Measuring 4. Replace PC 1672 Control Panel. If all diagnostics 038, 039, 040 are shown in the log, this is a possible fault.
x 100				039	... 00 27 ...	ALA: DIAG_CONTROL_NOT_FULLY_OPERATIONAL	**Fault:** CON is not in the same state as ALA. **Description:** CON is in Standby when ALA is in On (or vice versa) for more than 3.3 seconds. Technical alarm is generated. **What to do**: 1. Check if the Power switch is faulty and stuck between its fixed positions. If the switch is sluggish, adjust the knob. If all diagnostics 038, 039, 040 are shown in the log, this is a possible fault. 2. Replace PC 1730 Control 3. Replace PC 1672 Control Panel. If all diagnostics 038, 039, 040 are shown in the log, this is a possible fault.
x 100				040	... 00 28 ...	ALA: DIAG_PANEL_NOT_FULLY_OPERATIONAL	**Fault:** PAN is not in the same state as ALA. **Description:** PAN is in Standby when ALA is in On (or vice versa) for more than 3.3 seconds. Technical alarm is generated. **What to do**: 1. Check if the Power switch is faulty and stuck between its fixed positions. If the switch is sluggish, adjust the knob. If all diagnostics 038, 039, 040 are shown in the log, this is a possible fault. 2. Check that the PAN-PROM is correctly mounted 3. Replace PC 1672 Control Panel. If all diagnostics 038, 039, 040 are shown in the log, this is a possible fault.

x 510			x	042	... 00 2A ...	ALA: DIAG_VOLTAGE_ERROR_PLUS_15V_ON 1 GND 2 +15V 3 +24V_PTC 4 GND 5 -15V 6 +5V 7 GND 8 +24V_VALVE 9 +5V 10 GND 11 +24V_VALVE 12 +5V  **P59 / PC 1675**	**Fault:** Failure on the +15 voltage. **Description:** The supervision of the +15 voltage indicates that the voltage is outside specified limits (13.8 – 16.2 V). Alarm 510 is generated. **What to do**: 1. Check if +15 V / -15 V / +5 V is available at P59 on PC 1675 Power Supply, see below. 2. If +15V / -15V / +5 V is not available, disconnect the Power Supply cable at P82 on PC 1753 DC/DC Converter and repeat the voltage check at P59: 3. If the voltage still is not available, replace PC 1675 Power Supply. 4. If the voltage now is available, replace the Communication Interface (CPS/IDS). 5. Replace PC 1672 Control Panel. **Checking voltages** • Open the Power & Communication Interface. • Disconnect the battery cable. • Disconnect the Power Supply cable at P59 on PC 1675 Power Supply. • Connect the mains power cable to the AC/DC Converter cable. **Caution**: With mains power connected to the unit, there are energized electrical components inside the equipment. All personnel must exercise extreme caution when in the vicinity of this equipment if fault tracing or adjustments are performed with mains power supply connected and with the battery drawer opened. • Switch the KION workstation to Standby. • Check the voltage levels in connector P59 on PC 1675 Power Supply.
x 510			x	043	... 00 2B	ALA: DIAG_VOLTAGE_ERROR_MINUS_15V_ON	**Fault:** Failure in the -15 voltage **Description:** The supervision of the -15 voltage indicates that the voltage is outside specified limits (-13.8 V – -16.2 V). Alarm 510 is generated. **What to do**: Refer to Diagnostic Log 042
			x	044	... 00 2C ...	ALA: DIAG_CAN_BUS_OFF_SOLVED	**Information:** Hardware failure has been solved. Technical alarm has been sent before this diagnostic log. **What to do**: Power cycle the system and check that the technical alarm is gone.
			x	046	... 00 2E ...	ALA: DIAG_ON_STANDBY_OFF_SWITCH_ERROR	**Fault:** Failure in the Power switch detected. **Description:** The Power switch is toggling between the system states without being stable in the selected state. **What to do**: Check / replace the power switch

			x	047	... 00 2F ...	ALA: DIAG_LOW_BATTERY_STARTUP_VOLTAGE	**Fault:** Failure in the internal battery charging voltage. **Description:** The charging voltage is too low (when running on mains power) during startup hardware test. **What to do**: Check if +24V_PTC is available at P59 on PC 1675 Power Supply: • If +24V_PTC is not available, replace the AC/DC Converter. Note: As the two fans inside the battery drawer runs on +24 V, this error is easy to identify by checking the function of these fans. • If +24V_PTC is available, this voltage is correctly generated by the Power Supply system. The error must be found in the cables/connectors or on PC 1672 Control Panel.
x 100 830				049	... 00 31 ...	ALA: DIAG_ERROR_LINE_ERROR	**Fault:** Hardware failure during the startup test of sound generation and error line. **Description:** The Emergency line activates/deactivates the buzzer by checking that Sound Sense is activated/deactivated. If not, this diagnostic and DIAG_ALARM_BUZZER_ERROR (032) is written. Technical alarm and alarm 830 is generated. **What to do**: 1. Replace PC 1672 Control Panel 2. Replace PC 1737 Measuring. Check if any other adjacent diagnostic log can indicate this possible error. 3. Replace PC 1730 Control. Check if any other adjacent diagnostic log can indicate this possible error.
x 100				051	... 00 33 ...	ALA: DIAG_MEASURE_NOT_RESP_RESEND_ALARMS	**Fault:** MEA is not responding. **Description:** No acknowledge is received from this node on the RESEND_ALARMS message within 1 second. (Warm start). Technical alarm is generated. **What to do**: 1. Check that the MEA-PROM is correctly mounted 2. Replace PC 1737 Measuring.
x 100				052	... 00 34 ...	ALA: DIAG_CONTROL_NOT_RESP_RESEND_ALARMS	**Fault:** CON is not responding. **Description:** No acknowledge is received from this node on the RESEND_ALARMS message within 1 second. (Warm start). Technical alarm is generated. **What to do**: Replace PC 1730 Control.
x 100				053	... 00 35 ...	ALA: DIAG_PANEL_NOT_RESP_RESEND_ALARMS	**Fault:** PAN is not responding. **Description:** No acknowledge is received from this node on the RESEND_ALARMS message within 1 second. (Warm start). Technical alarm is generated. **What to do**: 1. Check that the PAN-PROM is correctly mounted 2. Replace PC 1672 Control Panel.

			x	056	... 00 38 ...	ALA: DIAG_FAN_FAILURE	**Fault:** PWR – Fan failure detected. **Description:** The supervision of the FAN_FAIL.H signal from the power supply unit is high when running on mains. **What to do**: Check / replace Battery drawer fan or AC/DC Converter fan.
			x	057	... 00 39 ...	ALA: DIAG_POWER_OFF_MESSAGE_WITHOUT_OFF	**Fault:** Power-off message without Power switch Off. **Description:** A Power-off message is received without ALA detects that the Power switch is in OFF position. **What to do**: 1. Restart the KION workstation 2. Check / replace Power switch.
x 100				058	... 00 3A ...	ALA: DIAG_OFF_WITHOUT_POWER_OFF_MESSAGE	**Fault:** Power switch Off without Power-off message. **Description:** The switch is in OFF position but no Power-off message is received within 2 seconds from CON (PC 1730). Technical alarm is generated. **What to do**: 1. Check / replace Power switch 2. Replace PC 1730 Control 3. Replace PC 1672 Control Panel.
x 100				059	... 00 3B ...	ALA: DIAG_ON_AND_CALIBRATION_TIMEOUT	**Fault:** Power switch set to On without PuC/Calibration ended. **Description:** The PuC/Calibration is not finished or interrupted correctly within 3 seconds when switching from Standby to On in PuC/Calibration mode. Technical alarm is generated. **What to do**: Restart the KION workstation and redo a complete Calibration and PuC.
			x	060	... 00 3C ...	ALA: DIAG_AD_CONVERTER_READ_ERROR	**Fault:** A/D converter hardware failure. **Description:** Failed to read from A/D converter. **What to do**: Replace PC 1672 Control Panel.
			x	061	... 00 3D ...	ALA: DIAG_AD_CONVERTER_START_ERROR	**Fault:** A/D converter hardware failure. **Description:** Failed to start the A/D converter. **What to do**: Replace PC 1672 Control Panel .
			x	063	... 00 3F ...	ALA: DIAG_SYS_CONFIG_DATA_CRC_EE_ERROR	**Fault:** Checksum error in ALA-PROM. **Description:** ALA system configuration data ALA-PROM CRC error during startup hardware test. **What to do**: 1. Replace the ALA-PROM 2. Replace PC 1672 Control Panel.
			x	064	... 00 40 ...	ALA: DIAG_MAX_POWER_EXCEEDED	**Fault:** Power consumption from external equipment connected to the KION workstation is too high. **Description:** The discharge current is more than 140 mA when running on mains power. **What to do**: Disconnect external equipment to reduce the power consumption.

			x	076	... 00 4C…	ALA: DIAG_LOW_BATTERY_CAPACITY_IN_BEGINNING_OF_TEST	**Fault:** Low battery capacity. **Description:** The internal batteries are below 23.5 V at the beginning of the discharge test (running on mains or battery). **What to do**: 1. Allow the batteries to charge during 6 hours. 2. Check / replace internal batteries.
			x	077	... 00 4D…	ALA: DIAG_BATTERY_VOLTAGE_DECREASING_TOO_FAST	**Fault:** Battery voltage decreasing too fast. **Description:** The internal battery voltage will decrease too fast when running on battery (more than 0.4 V per minute). **What to do**: Replace the internal batteries.
			x	105	... 00 69 ...	CON: DIAG_CAN_BUFFER_FULL	**Fault:** Communication bus (CAN) is not working. **Description:** The circular CAN receive buffer is full, at least one CAN-message is missed. Circular buffer holds 10 CAN-messages. **What to do**: 1. If this log is repeted several times; check CAN communicating units, i.e. microprocessor controlled PC boards, multigas analyzer, KION Monitor and DuoView. Also check PC board- and cable connectors. 2. Report to EM-HSC.
			x	106	... 00 6A ...	CON: DIAG_CAN_DATA_OVERRUN	**Fault:** Communication bus (CAN) is not working. **Description:** Data overrun has occurred, at least one CAN-message is missed. **What to do**: Replace PC 1730 Control.
			x	109	... 00 6D ...	CON: DIAG_CAN_WARNING_LIMIT_REACHED	**Fault:** Communication bus (CAN) is not working. **Description:** At least one error counter has reached warning limit. **What to do**: 1. If this log is repeted several times; check CAN communicating units, i.e. microprocessor controlled PC boards, multigas analyzer, KION Monitor and DuoView. Also check PC board- and cable connectors. 2. Report to EM-HSC.
			x	112	... 00 70 ...	CON: DIAG_CAN_READ_ERRROR	**Fault:** Internal program error. **Description:** SW-related problem. Error reading a CAN-message. Some parameter was out of range. **What to do**: Report to EM-HSC.
			x	113	... 00 71 ...	CON: DIAG_CAN_UNKNOWN_ MESSAGE	**Fault:** Internal program error e.g. due to incompatible sub-system SW-versions. **Description:** Unknown CAN-message is received from an other sub-system. **What to do**: 1. Check sub-system SW-compatibility. Refer to KION Compatibility Chart. 2. Report to EM-HSC.

			x	120	... 00 78 Sub data: ... AB CD EF GH IJ	CON: DIAG_SW_INFO	**Fault:** Internal program error. **Description:** Debugging diagnostic log regarding software. In some cases also error information, refer to sub data below. **What to do**: Check in sub data if the diagnostic log contains any information indicating an error. Report to EM-HSC. Check where the diagnostic log was sent in code: AB = Software module number CD EF = Line number in code GH IJ = Other information. Error detected if:

AB	GH IJ	Description:	What to do:
0C	00 0x	Failure to read A/D-port (DRV_IN module).	Replace PC 1730 Control.
28	01 00	E2-potentiometer write failure (CAL_E2P module).	Replace PC 1750 Transducer. Replace PC 1748/ PC 1797 Fresh gas flow.
56	00 00	Hardware high pressure detection in MEA is not working.	Redo a PuC and check that the Alarm detectors test works.
54	00 00	Fresh gas zeroing cannot be performed in manual ventilation mode (SCON HV module).	This diagnostic log may appear now and then, but most of the time the software corrects the problem automatically by doing an extra zeroing of the inspiratory fresh gas flow transducer. However, if appearing repeatedly; 1. Check that the Inspiratory fresh gas silicone rubber valve is correctly mounted. 2. Replace the Inspiratory fresh gas valve with PC 1751 step motor.
5A	00 00	E2-potentiometer read/ write failure at system startup,Off to Standby (SUP module). Note: Technical alarm is generated at system startup.	1. Replace PC 1750 Transducer. 2. Replace PC 1748/ PC 1797 Fresh gas flow. 3. Replace PC 1730 Control.

			x	121	... 00 79 ...	CON: DIAG_UNEXPECTED_SW_ EVENT	**Fault:** Internal program error. **Description:** Unrecoverable error has occurred and the CON software has restarted. The processor load has reached its maximum limit (red_error). **What to do**: Report to EM-HSC.
			x	185	... 00 B9 ... Sub data: ... AB CD EF GH	CON: DIAG_SOFTWARE_ VERSION	**Description:** Tells what version of CON and MEA software the system contains. This diagnostic log is written every start-up of system (Off to Standby/On). **AB CD** tells the MEA version label in decimal form. **EF GH** tells the CON version label in decimal form.
			x	200	... 00 C8 ... Sub data: ... AB CD	CON: DIAG_FGAS_FAILURE	**Fault:** Inspiratory fresh gas flow transducer is not working. **Description:** The measured fresh gas flow is much greater than the set fresh gas flow. Refer to diagnostic DIAG_FGAS_FAILURE_NO_LONGER (201). This diagnostic log cannot appear in non-rebreathing ventilation modes. This diagnostic log may appear now and then, but most of the time the software corrects the problem automatically by doing an extra zeroing of the inspiratory fresh gas flow transducer. **What to do**: If appearing repeatedly: 1. Run a PuC to calibrate the inspiratoty fresh gas flow transducer. 2. Check that the inspiratory fresh gas valve tube is correctly mounted. 3. Check that the inspiratory fresh gas valve works properly by measure the fresh gas flow with a calibration manometer on the auxiliary outlet. 4. Replace the inspiratory fresh gas flow transducer. 5. Replace PC 1748/1797 Fresh gas flow. 6. Report to EM-HSC. The measured fresh gas flow (1/10 ml/s) is presented in sub data in hexadecimal form.
			x	201	... 00 C9 ... Sub data: ... AB CD	CON: DIAG_FGAS_FAILURE_NO_LONGER	**Description:** This diagnostic log follows the diagnostic log DIAG_FGAS_FAILURE (200) or DIAG_FGAS_TRANSDUCER_FAILURE (204) when the faulty situation has been solved by software. The set fresh gas flow (1/10 ml/s) is presented in hexadecimal form.
			x	202	... 00 CA ... Sub data: ... AB CD	CON: DIAG_MIX_NO_EMPTY_DETECTION	**Fault:** PC 1752 Position sensor at the fresh gas pressure container is not working properly. **Description:** The fresh gas step motor is fully open, but no signal from the position sensor is detected. A backup filling of the fresh gas pressure container has been made. This diagnostic log may appear now and then without impact on the functionality. **What to do**: If appearing repeatedly: 1. Run a PuC to detect leakage and to calibrate the inspiratory fresh gas flow transducer. 2. Adjust the position of the PC 1752 Position sensor. The time (ms) since last bellows filling is presented in hexadecimal form.

x 100				203	... 00 CB …	CON: DIAG_FGAS_VALVE_CLOSED_ DETECTION_FAILURE	**Fault:** Fresh gas step motor “closed”- sensor is not working properly. **Description:** The step motor is demanded to close before zeroing of the inspiratory fresh gas flow transducer, but no signal that the step motor is closed is detected. Further attempts to perform zeroing is then made during next expiration phase. Technical alarm will be activated if the “closed signal” is not detected during 3 consecutive attempts. **What to do**: 1. Check that the Inspiratory fresh gas valve tube is correctly mounted. 2. Replace the Inspiratory fresh gas valve with PC 1751 step motor.
x 100				204	... 00 CC … Sub data: ... AB CD	CON: DIAG_FGAS_TRANSDUCER_ FAILURE	**Fault:** Fresh gas flow transducer is not working properly. **Description:** The fresh gas flow transducer measures a flow despite the stepper motor is closed. Refer to diagnostic DIAG_FGAS_FAILURE_NO_LONGER (201). Technical alarm will be activated if the faulty situation remains 25 seconds. This diagnostic log or technical alarm cannot come in non-rebreathing ventilation modes. This diagnostic log may appear now and then, but most of the time the software corrects the problem automatically by doing an extra zeroing of the inspiratory fresh gas flow transducer. **What to do**: If appearing repeatedly or at technical alarm: 1. Run a PuC to calibrate the inspiratory fresh gas flow transducer. 2. Check that the inspiratory fresh gas valve tube is correctly mounted. 3. If an external flowmeter is available, check that the inspiratory fresh gas valve works properly by measuring the fresh gas flow at the auxiliary fresh gas outlet. Set fresh gas flow to 5 l/min. Measured value 5 l/min ±15%. 4. Replace the inspiratory fresh gas flow transducer. 5. Replace PC 1748/PC 1797 Fresh gas flow transducer. The measured fresh gas flow (1/10 ml/s) is presented in hexadecimal form.
x 100				205	... 00 CD …	CON: DIAG_O2_VALVE_MALFUNCTION	**Fault:** Gas module - O2 valve is not working properly. **Description:** The gas module delivers less than set flow. Reference flow <67% of the “Set flow - 2 l/min” during 80 ms and 3 consecutive fillings. If the gas combination is O2/N2O, the N2O valve will be closed to prevent filling with only N2O. Technical alarm will be sent and the diagnostic log will be repeted every 4 minute. **What to do**: Replace the Gas module - O2 and check that the system delivers the correct O2 concentration afterwards (to verify that correct O2-flow is generated).
			x	229	... 00 E5 ... Sub data: ... 00 00 ... 00 01	CON: DIAG_SYSTEM_ACTIVITY	**Description:** Diagnostic log required only for advanced debugging. Pre-use check passed Pre-use check failed

					... 00 02		Pre-use check aborted
							Switching Breathing system: ... 01 xx = Ventilation mode switch or Standby → ON ... 02 xx = ON → Standby
					... 01 11		Circle system, Manual ventilation
					... 02 11		
					... 01 12		Circle system, Volume control
					... 02 12		
					... 01 13		Circle system, Pressure support
					... 02 13		
					... 01 14		Circle system, Pressure control
					... 02 14		
					... 01 21		Non-Rebreathing, Manual ventilation
					... 02 21		
					... 01 22		Non-Rebreathing, Volume control
					... 02 22		
					... 01 23		Non-Rebreathing, Pressure support
					... 02 23		
					... 01 24		Non-Rebreathing, Pressure control
					... 02 24		
					... 01 31		Aux Fresh Gas Outlet, Manual ventilation
					... 02 31		
					... 01 32		Aux Fresh Gas Outlet, Volume control
					... 02 32		
					... 01 33		Aux Fresh Gas Outlet, Pressure support
					... 02 33		
					... 01 34		Aux Fresh Gas Outlet, Pressure control
					... 02 34		
					... 03 00		Calibration passed
					... 03 01		Calibration failed
					... 03 02		Calibration aborted
		x		230	... 00 E6 ...	CON: DIAG_USER_INTERACTION_TIMEOUT	**Fault:** Calibration sequence not fulfilled. **Description:** The user has not respond with “calibration continue” when starting a calibration or accepted/set barometric pressure during calibration (10 minutes response timeout) **What to do**: Restart Calibration.

	x	x		231	... 00 E7 ...	CON: DIAG_ HERC_TIMEOUT	**Fault:** KION Monitor do not respond during PuC or Calibration. **Description:** The KION Monitor do not respond to commands within one second when performing a PuC or Calibration. **What to do**: 1. Change KION Monitor and check if error disappears 2. Check the function of the monitor docking station e.g by connecting an external docking station to P83 on PC 1753 in the Battery drawer. 3. Check/replace the CPS/IDS board.
	x			232	... 00 E8 ...	CON: DIAG_PUC_BIBD_INTERNAL_LEAKAGE	**Fault**: Leakage detected or one of the pressure transducers is not working properly during the Bellows position sensor calibration in the PuC. **Description:** Refer to sub data below **What to do**: Refer to sub data below.
					Sub data:		
					... 00 02	DGBD_WAIT_FOR_EMPTY_BAG	The Breathing bellows is emptied with a drive gas flow of 30 l/min. The Breathing bellows is not detected to be in lowest position after 30 seconds, i.e. the PEEP Pressure - Insp. pressure < 17.5 cmH2O. **What to do**: 1. Check the seal on the bellows base plate. 2. Check/replace EMV 7. 3. Check/replace the Drive gas module.
					... 00 05	DGBD_WAIT_FOR_FULL_BAG	The Breathing bellows is filled with a flow of 27 l/min from the AIR/N2O or O2 gas modules. The Breathing bellows is not in top position after 30 seconds, i.e. the Exp. Pressure - PEEP Pressure < 15 cmH2O. **What to do**: Check/replace the Breathing bellows (leakage).
					... 00 0B	DGBD_WAIT_FOR_FULL_BAG_FINAL_ CHECK	A final check that the calibrated Bellows position sensor is working by moving the bellows to top position again. The Breathing bellows is filled with a flow of 27 l/min from the AIR/N2O or O2 gas modules. The Breathing bellows is not detected to be in top position after 30 seconds, i.e. the Exp. Pressure - PEEP Pressure < 15 cmH2O. **What to do**: Check/replace the Breathing bellows (leakage).
			x	235	... 00 EB ...	CON: DIAG_TIMETEST_CURRENT_MAX_LOAD	**Description** : Incorrect SW version. **What to do**: Check the CON-SW version in component log and report to EM-HSC.
			x	236	... 00 EC ...	CON: DIAG_TIMETEST_TOTAL_MAX_LOAD	**Description** : Incorrect SW version. **What to do**: Check the CON-SW version in component log and report to EM-HSC.

			x	250	... 00 FA ...	CON: DIAG_BREATH_PHASE_FAILURE_SCON_STATE	**Fault:** Internal program error. **Description**: The software has detected a breathing phase synchronization failure and has been synchronized again. A new expiration has been generated to synchronize the software processes to solve this situation. **What to do**: 1. Single event: Report to EM-HSC. 2. Repeted events: Replace PC 1730 Control. If the error remains, remove the workstation from operation. Report to EM-HSC.
					Sub data:		
					... AB CD	ACTIVE_SCON_STATE	The failure has occurred when the “System Control”- process was in the state: ACTIVE_SCON_STATE (hexadecimal form).
			x	251	... 00 FB ...	CON: DIAG_BREATH_PHASE_FAIL_BREATHSYNC_CMV	**Fault:** Internal program error. **Description**: The software has detected a breathing phase synchronization failure and has been synchronized again. A new expiration has been generated to synchronize the software processes to solve this situation. **What to do**: 1. Single event: Report to EM-HSC. 2. Repeted events: Replace PC 1730 Control. If the error remains, remove the workstation from operation. Report to EM-HSC.
					Sub data:		
					... 00 00	Inspiration	The failure has occurred in the breathing phase: Inspiration
					... 00 01	Pause	The failure has occurred in the breathing phase: Pause
					... 00 02	Expiration	The failure has occurred in the breathing phase: Expiration
			x	252	... 00 FC ...	CON: DIAG_BREATH_PHASE_FAILURE_PEND_VENTMODE	**Fault:** Internal program error **Description**: The software has detected a breathing phase synchronization failure and has been synchronized again. A new expiration has been generated to synchronize the software processes to solve this situation. **What to do**: 1. Single event: Report to EM-HSC. 2. Repeted events: Replace PC 1730 Control. If the error remains, remove the workstation from operation. Report to EM-HSC.
					Sub data:		
					... 00 01	Manual ventilation	The error occurred when pending ventilation mode: Manual ventilation.
					... 00 02	Volume Control	The error occurred when pending ventilation mode: Volume control.
					... 00 03	Pressure Support	The error occurred when pending ventilation mode: Pressure support.
					... 00 04	Pressure Control	The error has occurred when pending ventilation mode: Pressure control.
					... 00 05	N/A	Internal program state.
					... 00 06	N/A	Internal program state.

			x	253	... 00 FD...	CON: DIAG_DGAS_BELLOW_FULL_IN_STANDBY	**Fault**: The Bellows position sensor is not working properly. **Description**: When system is in Standby, the Bellows position sensor signals that the Breathing bellows is in top position when it should be in its lowest position. **What to do**: 1. Check that nothing is obstructing/disturbing the sensor 2. Check for dirt/cracks on the Bellows housing. 3. Check/replace the Breathing bellows. The white ring on the bellows will not reflect the light to the sensor properly. 4. Replace PC 1766 Bellows position sensor 5. Replace PC 1750 Transducer.
			x	254	... 00 FE ... Sub data: ... AB CD	CON: DIAG_INIT_CON_E2POT_FAILURE	**Fault**: Stored calibration values in E2-potentiometer for the pressure- or flow transducers is not correct at system start-up (Off to Standby). Refer to sub data below. **Description**: The transducers calibration values are stored in two separate E2-potentiometer memories on PC 1750 Transducer and on PC 1748/PC 1797 Fresh gas flow. The E2-potentiometer contains both a non-volatile memory and a volatile memory. At start-up of the system, data in the non-volatile memory (REG0) is transferred to the volatile memory (WCR) for each transducer. After the transfer, a comparison test is made between the non-volatile and the volatile memory to see that the transfer completed successfully. If comparison fails, a diagnostic log is written. **What to do**: 1. Perform a Calibration and a PuC. Restart the KION workstation and check that the diagnostic log is not reproduced. 2. Replace PC 1750 Transducer if a digit is present in A, C or D. 3. Replace PC 1748/PC 1797 Fresh gas flow if a digit is present in B. 4. Replace PC 1730 Control.
			x	255	... 00 FF ... Sub data:	CON: DIAG_INIT_CON_E2POT_ALA_FAILURE	**Fault**: Stored calibration values for the pressure- or flow transducers is not correct at system start-up (Off to Standby). Refer to sub data below.

					... AB CD		**Description**: The transducers calibration values are stored in two separate E2-potentiometer memories on PC 1750 Transducer and on PC 1748/PC 1797 Fresh gas flow. All calibration values is also stored on PC 1672 Control panel. When the system is powered-up, the calibration values are compared to check that they match each other. If not, a diagnostic log is written. **What to do**: 1. Perform a Calibration and a PuC. Restart the KION workstation and check that the diagnostic log is not reproduced. 2. Replace PC 1750 Transducer if a digit is present in A, C or D. 3. Replace PC 1748/PC 1797 Fresh gas flow if a digit is present in B. 4. Replace the PC 1672 Control panel 5. Replace PC 1730 Control.
			x	256	... 01 00 ... Sub data: ... AB CD	CON: DIAG_INIT_MEA_E2POT_FAILURE	**Fault**: Stored calibration values for the pressure transducers are not correct at system start-up (Off to Standby). **Description**: The transducers calibration values are stored in two separate E2-potentiometer memories on PC 1750 Transducer. The E2-potentiometer contains both a non-volatile memory and a volatile memory. At start-up of the system, data in the non-volatile memory (REG0) is transferred to the volatile memory (WCR) for each transducer. After the transfer, a comparison test is made between the non-volatile and the volatile memory to see that the transfer completed successfully. If comparison fails, a diagnostic log is written. **What to do**: 1. Perform a Calibration and a PuC. Restart the KION workstation and check that the diagnostic log is not reproduced. 2. Replace PC 1750 Transducer if a digit is present in B, C or D. 3. Replace PC 1737 Measuring.
			x	257	... 01 01 ... Sub data:	CON: DIAG_INIT_MEA_E2POT_ALA_FAILURE	**Fault**: Stored calibration values for the pressure transducers are not correct at system start-up (Off to Standby). **Note**! This diagnostic log may appear before calibration when upgrading the MEA-PROM.

					... AB CD		**Description**: The transducers calibration values are stored in two separate E2-potentiometer memories on PC 1750 Transducer. All calibration values is also stored on PC 1672 Control panel. At system start-up, a comparison test is made to see that they match each other. If comparison fails, a diagnostic log is written. **What to do**: 1. Perform a Calibration and a PuC. Restart the KION workstation and check that the diagnostic log is not reproduced. 2. Replace PC 1750 Transducer if a digit is present in B, C or D. 3. Replace PC 1672 Control panel.
			x	258	... 01 02 ... Sub data: ... AB CD	CON: DIAG_INIT_MEA_E2POT_TRANS_TO_WCR_FAILURE	**Fault**: Transferred calibration values for the pressure- or flow transducers is not correct at system start-up (Off to Standby). **Description**: The transducers calibration values are stored in two separate E2-potentiometer memories on PC 1750. The E2-potentiometer contains both a non-volatile memory and a volatile memory. At start-up of the system, data in the non-volatile memory (REG0) is transferred to the volatile memory (WCR) for each transducer. After the transfer, a comparison test is made between the non-volatile and the volatile memory to see that the transfer completed successfully. If comparison fails, a diagnostic log is written. **What to do**: 1. Perform a Calibration and a PuC. Restart the KION workstation and check that the diagnostic log is not reproduced. 2. Replace PC 1750 Transducer if a digit is present in B, C or D. 3. Replace PC 1737 Measuring.
	x			260	... 01 04 …	CON: DIAG_PUC_SUPPLY_GAS_FAILURE	**Fault**: Gas supply failure during PuC. **Description**: Both AIR- and O2 gas supply are disconnected or the gas supply pressure is not enough when starting the PuC. Refer to chapter about “Check of control panel settings and of gas supply” during PUC **What to do**: 1. Connect gas supply or increase gas supply pressure. Required gas supply pressure: 280 – 600 kPa. 2. Replace PC 1720 Wall pressure.
	x			261	... 01 05 … Sub data:	CON: DIAG_PUC_AUTOVENT_LEAKAGE_FAILURE	**Fault**: “Leakage automatic ventilation” test failed during PuC **Description**: The test pressure is 40 cmH2O. **What to do**: Refer to section “If the Pre-use check fails” in this chapter and to information regarding “Leakage automatic ventilation” in chapter “Service procedures”, section “Pre-use check”.

					... 26 AE	CAL_ERR_START_P_TOO_LOW	**Fault**: PuC technical error code **9902**. Large leakage, disconnect. The volume could not be calculated, the test pressure was not reached in 15 seconds. The fresh gas filling flow was 20 l/min. **What to do**: Refer to section “If the Pre-use check fails”.
					... 26 AF	CAL_ERR_NOT_ENOUGH_P1_SAMPLES	**Fault**: PuC technical error code **9903**. The Start pressure could not be calculated as a mean value because the number of samples was less than 2 in 0.5 seconds. **What to do**: 1. Power cycle the system. 2. Replace PC 1730 Control
					... 26 B0	CAL_ERR_NOT_ENOUGH_P2_SAMPLES	**Fault**: PuC technical error code **9904**. The End pressure could not be calculated as a mean value because number of samples was less than 2 in 0,5 seconds. **What to do**: 1. Power cycle the system. 2. Replace PC 1730 Control
					... 26 B1	CAL_ERR_P_HIGHER_AFTER_DELAY	**Fault**: Pre-use check technical error code **9905**. Gas leakage into the workstation. The end pressure is more than 1 cmH2O above the start pressure. This could be due to a leakage into the system from a gas module, a mushroom valve, the O2-flush or emergency gas valves or from a disconnected sampling line. If the end pressure is above the start pressure, but the difference is less than 1 cmH2O, the system is assumed to be tight. **What to do**: Refer to section “If the Pre-use check fails”.
					... 26 B2	CAL_ERR_START_P_TOO_HIGH	**Fault**: PuC technical error code **9906**. The workstation is not evacuated. The system is not evacuated in 10 seconds after the last “pressure puff” before the ramp for volume calculation. The pressure is higher than 1.5 cmH2O. **What to do**: Refer to section “If the Pre-use check fails”.
					... 26 B3	CAL_ERR_START_P_TOO_LOW_2	**Fault**: PuC technical error code **9907**. Leakage 6-19 l/min. The initiated test pressure 41 cmH2O could not be reached in 5 attempts. **What to do**: Refer to section “If the Pre-use check fails”.
					... 26 B5	CAL_ERR_P_NOT_RAISE_ON_REFILL	**Fault**: PuC technical error code **9909**. Gas leakage in the workstation. The refilling flow is the “calculated leakage + 200 ml” for 5 seconds. If the pressure is not increasing, then an assumed leakage between the gas modules and the inspiratory gas block is detected. **What to do**: Refer to section “If the Pre-use check fails”.
	x			262	...01 06 …	CON: DIAG_PUC_AUTOVENT_NOT_ACCEPTABLE_LEAKAGE	**Fault**: “Leakage automatic ventilation” test failed during PuC. No error code stated. **Description**: The leakage was greater than 150 ml/min but not generating an error code. **What to do**: Refer to section “If the Pre-use check fails”.
					Sub data:		
					... AB CD	LEAKAGE_MORE_THAN_150_ML	The leakage (ml/min) is presented in hexadecimal form.

	x			263	... 01 07 … Sub data: ... 26 AE ... 26 AF ... 26 B0 ... 26 B1 ... 26 B2 ... 26 B3 ... 26 B5	CON: DIAG_PUC_HANDVENT_LEAKAGE_FAILURE CAL_ERR_START_P_TOO_LOW CAL_ERR_NOT_ENOUGH_P1_SAMPLES CAL_ERR_NOT_ENOUGH_P2_SAMPLES CAL_ERR_P_HIGHER_AFTER_DELAY CAL_ERR_START_P_TOO_HIGH CAL_ERR_START_P_TOO_LOW_2 CAL_ERR_P_NOT_RAISE_ON_REFILL	**Fault**: “Leakage manual ventilation” test failed during PuC. **Description**: The test pressure is 25 cmH2O. **What to do**: Refer to section “If the Pre-use check fails” in this chapter and to information regarding “Leakage manual ventilation” in chapter “Service procedures”, section “Pre-use check”. Refer to sub data for DIAG_PUC_AUTOVENT_LEAKAGE_FAILURE (261) Refer to sub data for DIAG_PUC_AUTOVENT_LEAKAGE_FAILURE (261) Refer to sub data for DIAG_PUC_AUTOVENT_LEAKAGE_FAILURE (261) Refer to sub data for DIAG_PUC_AUTOVENT_LEAKAGE_FAILURE (261) Refer to sub data for DIAG_PUC_AUTOVENT_LEAKAGE_FAILURE (261) Refer to sub data for DIAG_PUC_AUTOVENT_LEAKAGE_FAILURE (261) Refer to sub data for DIAG_PUC_AUTOVENT_LEAKAGE_FAILURE (261)
	x			264	...01 08 … Sub data: ... AB CD	CON: DIAG_PUC_HANDVENT_NOT_ACCEPTABLE_LEAKAGE LEAKAGE_MORE_THAN_150_ML	**Fault**: “Leakage manual ventilation” test failed during PuC. No error code stated. **Description**: The leakage was above 150 ml/min **What to do**: Refer to section “If the Pre-use check fails”. The leakage (ml/min) is presented in hexadecimal form.
	x			265	... 01 09 … Sub data: ... AB CD	CON: DIAG_PUC_QCHECK_INSP_PRESS_NOT_REACHED QCHECK_FAILED_TO_BUILD_UP_PRESSURE	**Fault**: “Checking pressure transducers” test failed during PuC. **Description**: Failed to build up pressure in system to 10 cmH2O (±4 cmH2O). MV1+MV5 are closed during this test sequence. The pressure is slowly build up with a fresh gas flow of 6 l/min until the Insp. pressure transducer measures 10 cmH2O. If the build-up pressure timeout of 10 s is reached, this diagnostic log is written. Refer to section “If the Pre-use check fails” in this chapter and to information regarding “Checking pressure transducers” in chapter “Service procedures”, section “Pre-use check”. **What to do**: 1. Perform a Calibration 2. Check for leakage in the system, i.e. check that pressure transducer tubes are properly connected. 3. Replace PC 1750 Transducer (or the concerned PC 1781). Reached build-up pressure (1/100 cmH2O) after 10 s measured by the insp. pressure transducer in hexadecimal form.

	x			266	... 01 0A … Sub data: ... AB CD	CON: DIAG_PUC_QCHECK_EXP_TRANSDUCER QCHECK_EXP_TRANSDUCER_PRESSURE	**Fault**: “Checking pressure transducers” test failed during PuC. **Description**: A comparison of each pressure transducer is performed. The first step is to build up pressure in the system with a fresh gas flow of 18 l/min until the Insp. pressure transducer measures 10 cmH2O where the flow is shut off. Acceptance tolerance 10 ±4 cmH2O. The second step is to build up pressure in the system with a fresh gas flow of 18 l/min until the Insp. pressure transducer measures 20 cmH2O where the flow is shut off. Acceptance tolerance 20 ±4 cmH2O. The last step is to evacuate the system during 2 s by opening the PEEP valve. Acceptance tolerance 0 ±4 cmH2O. MV1-MV5 are opened during all steps. **Note**: All the diagnostic log 266, 267, 268 and 269 is shown in log to see witch pressure transducer that is out of “acceptance tolerance” when the “Check of pressure transducers” in PuC fails. Refer to section “If the Pre-use check fails” in this chapter and to information regarding “Checking pressure transducers” in chapter “Service procedures”, section “Pre-use check”. **What to do:** 1. Perform a Calibration. 2. Check for leakage in the system, i.e. check that pressure transducer tubes are properly connected. 3. Replace PC 1750 Transducer (or the concerned PC 1781). The pressure measured (1/100 cmH2O) by the Exp. pressure transducer is presented in sub data in hexadecimal form.
	x			267	... 01 0B … Sub data: ... AB CD	CON: DIAG_PUC_QCHECK_INSP_TRANSDUCER QCHECK_INSP_TRANSDUCER_PRESSURE	**Fault**: Refer to DIAG_PUC_QCHECK_EXP_TRANSDUCER (266) The pressure measured (1/100 cmH2O) by the Insp. pressure transducer is presented in sub data in hexadecimal form.
	x			268	... 01 0C … Sub data: ... AB CD	CON: DIAG_PUC_QCHECK_PEEP_TRANSDUCER QCHECK_PEEP_TRANSDUCER_PRESSURE	**Fault**: Refer to DIAG_PUC_QCHECK_EXP_TRANSDUCER (266) The pressure measured (1/100 cmH2O) by the PEEP pressure transducer is presented in sub data in hexadecimal form.
	x			269	... 01 0D … Sub data: ... AB CD	CON: DIAG_PUC_QCHECK_MANBAG_TRANSDUCER QCHECK_MANBAG_TRANSDUCER_PRESSURE	**Fault**: Refer to DIAG_PUC_QCHECK_EXP_TRANSDUCER (266) The pressure measured (1/100 cmH2O) by the Man. pressure transducer is presented in sub data in hexadecimal form.

<table>
<tr>
<td></td><td>x</td><td></td><td></td><td>270</td><td>...01 0E …</td><td>CON:
DIAG_PUC_FGAS_TRANSDUCER_CAL_FAILURE</td><td>Fault: The calibration of the fresh gas flow transducer failed during the “Checking flow transducers” test in the PuC.
Refer to information regarding “Checking flow transducers” in chapter “Service procedures”, section “Pre-use check”.
Valve settings during the fresh gas flow transducer calibration in PuC:
<table><tr><th>Valve</th><th>Name of valve</th><th>Open/Closed</th></tr><tr><td>MV1</td><td>MUSH_HAND_CIRCLE</td><td>CLOSED</td></tr><tr><td>MV2</td><td>MUSH_POPOFF</td><td>OPEN</td></tr><tr><td>MV3</td><td>MUSH_BAG</td><td>OPEN</td></tr><tr><td>MV4</td><td>MUSH_ABSORBER</td><td>OPEN</td></tr><tr><td>MV5</td><td>MUSH_HAND_OPEN</td><td>CLOSED</td></tr><tr><td>Fr. gas</td><td>FGAS_VALVE</td><td>OPEN</td></tr><tr><td>PEEP</td><td>PEEP_VALVE</td><td>OPEN</td></tr></table></td>
</tr>
<tr>
<td></td><td></td><td></td><td></td><td></td><td>Sub data:</td><td></td><td></td>
</tr>
<tr>
<td></td><td></td><td></td><td></td><td></td><td>... 00 0A</td><td>CAL_FGAS_OFFSET_INIT_FAIL</td><td>Fault: Failed to write data to the fresh gas flow transducer E2-potentiometer memory.
Description: CON/PC 1730 is responsible for communication and initiating the fresh gas E2-potentiometer over the I2C bus.
What to do:
1. Replace PC 1748/PC 1797 Fresh gas flow.
2. Replace PC 1730 Control.</td>
</tr>
<tr>
<td></td><td></td><td></td><td></td><td></td><td>... 00 0B</td><td>CAL_FGAS_OFFSET_FAIL</td><td>Fault: The offset calibration of the fresh gas flow transducer failed.
CON is responsible for calibration of this transducer.
Description: The fresh gas flow is zero during offset calibration of the fresh gas flow transducer E2-potentiometer. The fresh gas flow transducers E2-potentiometers are adjusted during calibration until the measured flow is close to the target value.
Displays on Control panel:
The Tidal Volume display shows the target value: 50 (1/10 ml/s)
The Exp. Tidal Volume display shows the measured flow value (1/10 ml/s)
What to do:
1. Replace the fresh gas flow transducer.
2. Replace PC 1748/PC 1797 Fresh gas flow.</td>
</tr>
<tr>
<td></td><td></td><td></td><td></td><td></td><td>... 00 0C</td><td>CAL_FGAS_GAIN_INIT_FAIL</td><td>Fault: Failed to write data to the fresh gas flow transducer E2-potentiomerter memory.
Description: CON/PC 1730 is responsible for communication and initiating the fresh gas E2-potentiometer over the I2C bus.
What to do:
1. Replace PC 1748/PC 1797 Fresh gas flow
2. Replace PC 1730 Control.</td>
</tr>
</table>

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td>... 00 0D</td><td>CAL_FGAS_GAIN_FAIL</td><td>Fault: The gain calibration of the fresh flow gas transducer failed.
CON is responsible for calibration of this transducer.
Description: The fresh gas flow from the AIR/N2O or O2 gas modules are 5 l/min (target value) during the gain calibration of the fresh gas flow transducer E2-potentiometer. The fresh gas flow transducers E2-potentiometers are adjusted during calibration until the measured flow is close to the target value.
The acceptance criteria for successful gain calibration is that the measured flow do not differ more than 0.5% from the target value. If not, this diagnostic log is written.
Displays on Control panel:
The Tidal Volume display shows the target value: 833 (=5 l/min).
The Exp. Tidal Volume display shows the measured flow value by the fresh gas flow transducer (1/10 ml/s).
What to do:
1. Replace the fresh gas flow transducer.
2. Replace PC 1748/PC 1797 Fresh gas flow.
3. Replace the gas module:
- If Air supply gas is connected: AIR/N2O gas module
- If Air supply gas is not connected: O2 gas module.</td></tr>
<tr><td></td><td>x</td><td></td><td></td><td>271</td><td>... 01 0F …

Sub data:</td><td>CON:
DIAG_PUC_EXP_TRANCDUCER_CAL_FAILURE</td><td>Fault: The calibration of the expiratory flow transducer failed during the “Checking flow transducers” test in the PuC.
Refer to information regarding “Checking flow transducers” in chapter “Service procedures”, section “Pre-use check”.
Valve settings during the Exp. flow transducer calibration in PuC:
<table><tr><th>Valve</th><th>Name of valve</th><th>Open/Closed</th></tr><tr><td>MV1</td><td>MUSH_HAND_CIRCLE</td><td>CLOSED</td></tr><tr><td>MV2</td><td>MUSH_POPOFF</td><td>OPEN</td></tr><tr><td>MV3</td><td>MUSH_BAG</td><td>OPEN</td></tr><tr><td>MV4</td><td>MUSH_ABSORBER</td><td>OPEN (Offset calibration)
* CLOSED (Gain calibration)</td></tr><tr><td>MV5</td><td>MUSH_HAND_OPEN</td><td>CLOSED</td></tr><tr><td>Fr. gas</td><td>FGAS_VALVE</td><td>OPEN</td></tr><tr><td>PEEP</td><td>PEEP_VALVE</td><td>OPEN</td></tr></table>* MV4 is closed during the gain calibration to get a correct calibration also if the inspiratory direction valve is leaking</td></tr>
</table>

					... 00 0A	CAL_EXP_OFFSET_MEA_FAIL	**Fault**: The offset calibration of the Exp. flow transducer failed. MEA is responsible for calibration of this transducer. **Description**: The flow is zero (target value) during offset calibration of the Exp. flow transducer E2-potentiometer. The Exp. flow transducers E2-potentiometers are adjusted during calibration until the measured flow is close to the target value. Refer to chapter about Exp. flow transducer calibration during PUC. *Displays on Control panel:* The Tidal Volume display shows the target value: 0 The Exp. Tidal Volume display shows the measured flow by the Exp. flow transducer. **What to do:** 1. Replace the Exp. flow transducer. 2. Replace PC 1750 Transducer. 3. Check the electric connection to the flow transducer (N126/P126).
					... 00 0B	CAL_EXP_GAIN_MEA_FAIL	**Fault**: The gain calibration of the Exp. flow transducer failed. MEA is responsible for calibration of this transducer. **Description**: The fresh gas flow is 14 l/m during 3 seconds (**=**700 ml). Several attempts (max 14) when calibrating the gain of the Exp flow transducer. The Exp. flow transducers E2-potentiometers are adjusted on every attempt until the measured volume is close to the target value (700 ml). Between every attempt the Exp. flow transducer is zeroed. After 14 attempts, if the calculated volume is not close to 700 ml, this diagnostic log is written. *Displays on Control panel:* The Tidal Volume display shows the target value: 700 The Exp. Tidal Volume display shows the measured volume (ml) after each attempt . **What to do:** 1. Replace the Exp. flow transducer. 2. Replace PC 1750 Transducer. 3. Replace the gas module: - If Air supply gas is connected: AIR/N2O gas module. - If Air supply gas is not connected: O2 gas module. 4. Check the electric connection to the flow transducer (N126/P126).

	x			272	... 01 10 …	CON: DIAG_PUC_BIBD_SHOWS_ALWAYS_EMPTY	**Fault**: The Bellows position sensor is not working. The Checking bellows level detector-test fails. **Description**: When the Bellows position sensor has been calibrated, a test is made to check that the sensor detects that the bellows is in top position. When the bellows moves to top position and the sensor cannot detect this position, this diagnostic log is written. Refer to information regarding “Checking bellows detector” in chapter “Service procedures”, section “Pre-use check”. **What to do**: 1. Check that nothing is obstructing/disturbing the sensor. 2. Check for dirt/cracks on the Bellows housing. 3. Check that the Bellows position sensor is mounted in correct position (level). Refer to section “If the Pre-use Check fails”. 4. Check/replace the Breathing bellows. The white ring on the bellows will not reflect the light to the sensor properly. 5. Replace PC 1766 Bellows position sensor. 6. Replace PC 1750 Transducer.
	x			273	... 01 11 …	CON: DIAG_PUC_BIBD_SHOWS_ALWAYS_FULL	**Fault**: The Bellows position sensor is not working. The Checking bellows level detector-test fails. **Description**: When the Bellows position sensor has been calibrated, a test to see if the sensor detects that the bellows leaves its top position is made. The breathing bellows will not move towards top position because the sensor already detects that the breathing bellows is in top position. Refer to information regarding “Checking bellows detector” in chapter “Service procedures”, section “Pre-use check”. **What to do:** 1. Check that nothing is obstructing/disturbing the sensor. 2. Check for dirt/cracks on the Bellows housing. 3. Check that the Bellows position sensor is mounted in correct position (level). Refer to section “If the Pre-use Check fails”. 4. Replace PC 1766 Bellows position sensor. 5. Replace PC 1750 Transducer.
	x			274	... 01 12… Sub data: ... 00 0A	CON: DIAG_PUC_BIBD_E2POT_FAILURE CAL_BIB_DETECTOR_E2_POT_FAIL	**Fault**: The Checking bellows level detector-test fails. **Description**: Refer to information regarding “Checking bellows detector” in chapter “Service procedures”, section “Pre-use check”. **Fault**: Failed to write data to the Bellows position sensor E2-potentiomerter memory. **Description**: CON is responsible for communication and initiating the Bib sensor E2-potentiometers over the I2C bus. **What to do:** 1. Replace PC 1750 Transducer. 2. Replace PC 1730 Control.

					... 00 0B	CAL_BIB_DETECTOR_CALIB_FAIL	**Fault**: Failed to calibrate Bellows position sensor. **Description**: The difference between the E2-potentiometer value for empty bellows and full bellows is less than 5 units. The difference value is shown in the Exp. minute volume display. **What to do:** 1. Check that nothing is obstructing/disturbing the sensor. 2. Check for dirt/cracks on the Bellows housing. 3. Check that the Bellows position sensor is mounted in correct position (level). Refer to section “If the Pre-use Check fails”. 4. Check/replace the Breathing bellows. The white ring on the bellows will not reflect the light to the sensor properly. 5. Replace PC 1766 Bellows position sensor. 6. Replace PC 1750 Transducer.

<table>
<tr>
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<td>275</td>
<td>... 01 13 …</td>
<td>CON:
DIAG_PUC_MUSHROOM_PRESSURIZING_FAILURE</td>
<td>
Fault: Failed to pressurize system to appropriate level during mushroom valve test in PuC. The Checking mushroom valves-test fails.
Description: Refer to information regarding “Checking mushroom valves” in chapter “Service procedures”, section “Pre-use check”.
During the mushroom valve test in PuC, the mushroom valves are pressurized on one side. Thereafter, the pressure on the other side is measured. In case of leakage, a pressure is built-up on the other side of the valves. The PEEP valve is closed during the test.
Tests order: MV1, MV2, MV3, MV4, MV5, OV12.
Refer to sub data to identify the valve reporting failure during the PuC.
Note: Sub data states error on one of the valves, but the actual error may however also be found at one of the valves that remains to be tested.
Criteria for successful pressurizing of mushroom valves:
<table>
<tr><th>Valve for test</th><th>Pressure (cmH2O)</th><th>Gas used to pressurize</th><th>Mushroom valves open during the test</th></tr>
<tr><td>MV1</td><td>INSP > 25</td><td>Fresh gas</td><td>None</td></tr>
<tr><td>MV2</td><td>INSP > 25</td><td>Fresh gas</td><td>None</td></tr>
<tr><td>MV3</td><td>INSP > 25</td><td>Fresh gas</td><td>None</td></tr>
<tr><td>MV4</td><td>PEEP > 25</td><td>Drive gas</td><td>MV2</td></tr>
<tr><td>MV5</td><td>MAN > 15</td><td>Drive gas</td><td>MV1,MV2</td></tr>
<tr><td>OV12</td><td>INSP > 25</td><td>Fresh gas</td><td>None</td></tr>
</table>
If the pressurizing criteria for the mushroom valve tested is not fulfilled, this diagnostic log is written.
What to do:

Remove the cassette and check/clean the mushroom valves and the patient cassette support plate. Check each individual mushroom valve for possible defectives.
Replace the valve assembly plate.
Check/replace the patient cassette
Check the mushroom valve control gas supply pressure (20 kPa delivered by REG 1). For adjustment of REG 1, refer to the tool “Pressure Tester 0.2 bar regulator”, Order No. 65 62 479.

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</tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Sub data:</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>... 00 01</td><td>MUSH_HAND_CIRCLE</td><td>MV1</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>... 00 02</td><td>MUSH_POPOFF</td><td>MV2</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>... 00 03</td><td>MUSH_BAG</td><td>MV3</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>... 00 04</td><td>MUSH_ABSORBER</td><td>MV4</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>... 00 05</td><td>MUSH_HAND_OPEN</td><td>MV5</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>... 00 0B</td><td>UNI_DIRECTION_VALVE</td><td>OV12</td></tr>
</table>

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<tr>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td>276</td>
<td>... 01 14 …</td>
<td>CON:
DIAG_PUC_MUSHROOM_LEAKAGE_BEFORE_OPEN_FAILURE</td>
<td>
Fault: A mushroom valve leakage has been detected during the PuC. The Checking mushroom valves-test fails.
Description: Refer to information regarding “Checking mushroom valves” in chapter “Service procedures”, section “Pre-use check”.
During the mushroom valve test in PuC, the mushroom valves are pressurized on one side. Thereafter, the pressure on the other side is measured. In case of leakage, a pressure is built-up on the other side of the valves. The PEEP valve is closed during the test.
Tests order: MV1, MV2, MV3, MV4, MV5, OV12.
Refer to sub data to see witch valve that was tested in the sequence when failure occurs.
Note: Sub data states error on one of the valves, but the actual error may however also be found at one of the valves that remains to be tested.
Criteria to insure no leakage in the mushroom valves:
<table>
<tr><th>Valve for test</th><th>Pressure (cmH2O)</th><th>Mushroom valves open during the test</th></tr>
<tr><td>MV1</td><td>MAN < 10</td><td>None</td></tr>
<tr><td>MV2</td><td>PEEP<10</td><td>None</td></tr>
<tr><td>MV3</td><td>PEEP<10</td><td>None</td></tr>
<tr><td>MV4</td><td>INSP < 10</td><td>MV2</td></tr>
<tr><td>MV5</td><td>INSP < 10</td><td>MV1,MV2</td></tr>
<tr><td>OV12</td><td>MAN < 10</td><td>None</td></tr>
</table>
If the “no leakage” pressure criteria for the mushroom valve tested is <u>not</u> fulfilled, this diagnostic log is written.
What to do:

Remove the cassette and check/clean the mushroom valves and the patient cassette support plate. Check each individual mushroom valve for possible defectives.
Replace the valve assembly plate.
Check/replace the patient cassette
Check the mushroom valve control gas supply pressure (20 kPa delivered by REG 1). For adjustment of REG 1, refer to the tool “Pressure Tester 0.2 bar regulator”, Order No. 65 62 479.

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</tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Sub data:</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>... 00 01</td><td>MUSH_HAND_CIRCLE</td><td>MV1</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>... 00 02</td><td>MUSH_POPOFF</td><td>MV2</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>... 00 03</td><td>MUSH_BAG</td><td>MV3</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>... 00 04</td><td>MUSH_ABSORBER</td><td>MV4</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>... 00 05</td><td>MUSH_HAND_OPEN</td><td>MV5</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>... 00 0B</td><td>UNI_DIRECTION_VALVE</td><td>OV12</td></tr>
</table>

	x			277	... 01 15 …	CON: DIAG_PUC_MUSHROOM_LEAKAGE_AFTER_OPEN_FAILURE	**Fault**: The pressure is not consistent on both of the sides of the mushroom valve, despite that the mushroom valve should have opened , when tested in PuC. The Checking mushroom valves-test fails. **Description**: Refer to information regarding “Checking mushroom valves” in chapter “Service procedures”, section “Pre-use check”. During the mushroom valve test in PuC, the mushroom valves are pressurized on one side. Thereafter, the pressure on the other side is measured. In case of leakage, a pressure is built-up on the other side of the valves. This final test checks that the valves opens correctly and the pressure is consistent on both side of the mushroom valves. The PEEP valve is closed during the test. Tests order: MV1, MV2, MV3, MV4, MV5, OV12 Refer to sub data to see witch valve that was tested in the sequence when failure occurs. Note: Sub data states error on one of the valves, but the actual error may however also be found at one of the valves that remains to be tested Criteria to ensure equal pressure on both sides of the valve after 5 seconds when opening mushroom valves:

Valve for test	Pressure (cmH2O)	Mushroom valves open during the test
MV1	MAN > INSP - 10	MV1
MV2	PEEP > INSP - 10	MV2
MV3	PEEP > INSP - 10	MV3
MV4	INSP > PEEP - 10	MV4
MV5	INSP > MAN - 10	MV5
OV12	INSP > 10	MV5*

							*The MV5 is opened when the OV12 valve is tested. If there is a leakage in OV12, the gas will flow into the manual breathing bag with a pressure decrease as consequence. If the pressure consistent criteria for the mushroom valve tested is not fulfilled this diagnostic log is written. **What to do:** 1. Check the function of EMV1-5. Refer to information in section “If the Pre-use check fails” regarding the mushroom valve test. 2. Check the mushroom valve control gas supply pressure (20 kPa delivered by REG 1). For adjustment of REG 1, refer to the tool “Pressure Tester 0.2 bar regulator”, Order No. 65 62 479. If the pressure is too high, the mushroom valves may stick in inflated position inside the cassette
					Sub data:		
					... 00 01	MUSH_HAND_CIRCLE	MV1
					... 00 02	MUSH_POPOFF	MV2
					... 00 03	MUSH_BAG	MV3
					... 00 04	MUSH_ABSORBER	MV4

					... 00 05 ... 00 0B	MUSH_HAND_OPEN UNI_DIRECTION_VALVE	MV5 OV12
	x			278	... 01 16 …	CON: DIAG_PUC_HIGH_PRS_ALARM_FAILURE.	**Fault**: The hardware high pressure alarm is not working when tested in PuC. The Checking alarm detectors-test fails. **Description**: Refer to information regarding “Checking alarm detectors” in chapter “Service procedures”, section “Pre-use check”. The system will be pressurized with fresh gas until the hardware pressure alarm, 5 cmH2O above set UPL, is activated. The diagnostic log appears when: • Alarm is not activated and the Insp. pressure is higher than the set UPL +10 cmH2O. • Alarm is activated, but the Insp. pressure is less than the set UPL. • Alarm is activated, but the Insp. pressure is not decreasing after 1 second when evacuating system. **What to do:** 1. Check for obstruction in the EVAC system. 2. Replace the UPL potentiometer. 3. Replace PC 1737 Measuring. 4. Replace PC 1750 Transducer alt. PC 1781 (INSP).
	x			279	... 01 17 Sub data: ... AB CD	CON: CON: DIAG_PUC_UPPER_PRS_LIMIT_NOT_SET UPPER_PRESSURE_LIMIT_SETTING	**Fault**: The UPL knob is not set correctly when PuC starts. **Description**: Refer to information regarding “Check of control panel settings and of gas supply” in chapter “Service procedures”, section “Pre-use check”. The PUC starts with a check that the UPL is set between 60-80 cmH2O. **What to do**: 1. Set UPL knob to 70 cmH2O. 2. Check/replace UPL control panel potentiometer. The knob may be incorrectly mounted on the potentiometer shaft. Shows the UPL knob setting (1/100 cmH2O) in hexadecimal form.
		x		280	... 01 18 …	CON: DIAG_CAL_SUPPLY_GAS_FAILURE	**Fault**: Gas supply missing during Calibration. **Description**: Refer to information regarding “Check of control panel settings and of gas supply” in chapter “Service procedures”, section “Calibration”. Both AIR- and O2 supply gas is disconnected from the system or supply pressure is not enough when starting Calibration. **What to do**: 1. Connect gas supply or increase gas supply pressure. Required gas supply pressure: 280 – 600 kPa. 2. Replace PC 1720 Wall pressure.

		x		281	... 01 19 … Sub data:	CON: DIAG_CAL_PRS_TRANSDUCER_PEEP_FAILURE	**Fault**: Calibration of pressure transducer 3 fails (PEEP). **Description**: Refer to information regarding “Calibrating pressure transducers” in chapter “Service procedures”, section “Calibration”. CON is responsible for calibration of this transducer.
					... 00 0A	CAL_PRS_OFFSET_INIT_FAIL	**Fault**: Failed to write data to the PEEP pressure transducer E2-potentiometer memory. **Description**: CON is responsible for communication and initiating the PEEP pressure transducer E2-potentiometer over the I2C bus. **What to do:** 1. Replace PC 1750 Transducer. 2. Replace PC 1730 Control.
					... 00 0B	CAL_PRS_OFFSET_FAIL	**Fault**: The first offset calibration of the PEEP pressure transducer failed. **Description**: The system pressure is zero during offset calibration of the PEEP transducer E2-potentiometers. The PEEP transducers E2-potentiometers are adjusted during calibration until the transducer value is close to zero. The timeout for calibration is 64 attempts or 30 seconds to adjust PEEP transducers E2-potentiometers. *Displays on Control panel:* The Tidal Volume display shows the target value: 0. The Exp. Tidal Volume display shows the adjusting transducer value in 1/100 cmH2O. **What to do:** 1. Replace PC 1750 Transducer alt. PC 1781 (PEEP). 2. Replace PC 1730 Control.
					... 00 0C	CAL_PRS_OFFSET2_INIT_FAIL	Refer to CAL_PRS_OFFSET_INIT_FAIL (…00 0A) above.
					... 00 0D	CAL_PRS_OFFSET2_FAIL	**Fault**: The second offset calibration of the PEEP pressure transducer failed. **Description**: The offset adjustments of the PEEP pressure transducer E2-potentiometers is repeated but with a negative offset (-25 cm H2O or -10 cmH2O with PC1750C) to enable measurement of negative pressures. *Displays on Control panel:* The Tidal Volume display shows the target: 2500 (1000 with PC 1750C). The Exp. Tidal Volume display shows the adjusting transducer value in 1/100 cmH2O. **What to do:** Refer to CAL_PRS_OFFSET_FAIL (…00 0B) above.
					... 00 0E	CAL_PRS_GAIN_INIT_FAIL	Refer to CAL_PRS_OFFSET_INIT_FAIL (…00 0A) above.

					... 00 0F	CAL_PRS_GAIN_FAIL	**Fault**: The gain calibration of the PEEP pressure transducer failed. **Description**: The operator is demanded to pressurize the system by setting a flow using the Fresh Gas Flow knob and to enter the pressure value read on the calibration manometer using the Preset O_2 Conc. knob. The PEEP transducers E2-potentiometers are adjusted during calibration until the transducer value is close to system pressure. The timeout for calibration is 64 attempts or 30 seconds to adjust PEEP transducers E2-potentiometers. *Displays on Control panel:* The Tidal Volume display shows the target value in 1/100 cmH2O, i.e. the system pressure adjusted by the user. The Exp. Tidal Volume display shows the adjusting transducer value in 1/100 cmH2O. **What to do:** 1. Check for leakage in the system. 2. Replace PC 1750 Transducer alt. PC 1781 (PEEP). 3. Replace PC 1730 Control.
		x		282	... 011A … Sub data: ... 00 0B	CON: DIAG_CAL_PRS_TRANSDUCER_EXP_FAILURE CAL_PRS_OFFSET_FAIL	**Fault**: Calibration of pressure transducer 1 fails (EXP). **Description**: Refer to information regarding “Calibrating pressure transducers” in chapter “Service procedures”, section “Calibration”. MEA is responsible for calibration of this transducer. **Fault**: The first offset calibration of the EXP pressure transducer failed **Description**: The system pressure is zero during offset calibration of the EXP pressure transducer E2-potentiometer. The EXP pressure transducers E2-potentiometers are adjusted during calibration until the transducer value is close to zero (+15cmH20 with PC1750C). *Displays on Control panel:* The Tidal Volume display shows the target value: 0 (102 if PC1750C). A/D value. The Exp. Tidal Volume display shows the adjusting transducer value. values displayed is converted from cmH20 to corresponding A/D-value. **What to do:** 1. Replace PC 1750 Transducer 2. Replace PC 1737 Measuring.

					... 00 0F	CAL_PRS_GAIN_FAIL	**Fault** The gain calibration of the EXP pressure transducer failed. **Description**: The drive gas regulates a stable system pressure of 40-50cmH2O, with the already calibrated PEEP pressure transducer as reference, during gain calibration of the EXP pressure transducer. The EXP transducers E2-potentiometers are adjusted during calibration until the transducer value is close to system pressure. *Displays on Control panel:* The Fresh Gas Flow digit display shows the pressure measured by the INSP pressure transducer until a stable pressure is reached. The Preset O2 Conc. digit display shows the pressure measured by the EXP pressure transducer until a stable pressure is reached. The Minute Volume display shows the pressure measured by the PEEP pressure transducer until a stable pressure is reached. The Tidal Volume display shows the system pressure (target value). Values displayed is converted from cmH20 to corresponding A/D-value. The Exp. Tidal Volume display shows the adjusting transducer value. Values displayed is converted from cmH20 to corresponding A/D-value. **What to do:** 1. Check for leakage in the system. 2. Replace PC 1750 Transducer. 3. Replace PC 1737 Measuring. 4. Replace the Drive gas module.
					... 00 0D	CAL_PRS_OFFSET2_FAIL	**Fault** The second offset calibration of the EXP pressure transducer failed. **Description**: The offset adjustments of the **INSP** pressure transducer E2-potentiometers is repeated but with a negative offset (-25 cmH2O or -10 cmH2O with PC1750C) to enable measurement of negative pressures. *Displays on Control panel:* The Tidal Volume display shows the target value: 170 (A/D value for 25 cmH2O). The Exp. Tidal Volume display shows the adjusting transducer value. Values displayed is converted from cmH20 to corresponding A/D-value. **What to do:** Refer to CAL_PRS_OFFSET_FAIL (... 00 0B) above.
		x		283	... 01 1B … Sub data:	CON: DIAG_CAL_PRS_TRANSDUCER_INSP_FAILURE	**Fault** Calibration of pressure transducer 2 fails (INSP). **Description**: Refer to information regarding “Calibrating pressure transducers” in chapter “Service procedures”, section “Calibration”. MEA is responsible for calibration of this transducer.

						... 00 0B	CAL_PRS_OFFSET_FAIL	**Fault**: The first offset calibration of the INSP pressure transducer failed. **Description**: The system pressure is zero during offset calibration of the INSP pressure transducer E2-potentiometer. The INSP pressure transducers E2-potentiometers are adjusted during calibration until the transducer value is close to zero (+15cmH20 with PC1750C). *Displays on Control panel:* The Tidal Volume display shows the target value: 0 (102 if PC1750C). A/D value. The Exp. Tidal Volume display shows the adjusting transducer value. Values displayed is converted from cmH20 to corresponding A/D-value. **What to do:** 1. Replace PC 1750 Transducer. 2. Replace PC 1737 Measuring.
						... 00 0F	CAL_PRS_GAIN_FAIL	**Fault** The gain calibration of the INSP pressure transducer failed. **Description**: The drive gas regulates a stable system pressure of 40-50 cmH2O, with the already calibrated PEEP pressure transducer as reference, during gain calibration of the INSP pressure transducer. The INSP transducers E2-potentiometers are adjusted during calibration until the transducer value is close to system pressure. *Displays on Control panel:* The Fresh Gas Flow digit display shows the pressure measured by the INSP pressure transducer until a stable pressure is reached. The Preset O2 Conc. digit display shows the pressure measured by the EXP pressure transducer until a stable pressure is reached. The Minute Volume display shows the pressure measured by the PEEP- pressure transducer until a stable pressure is reached. The Tidal Volume display shows the system pressure (target value). *Values displayed is converted from cmH20 to corresponding A/D-value.* The Exp. Tidal Volume display shows the adjusting transducer value. *Values displayed is converted from cmH20 to corresponding A/D-value*. **What to do:** 1. Check for leakage in the system 2. Replace PC 1750 Transducer. 3. Replace PC 1737 Measuring. 4. Replace the Drive gas module.

					... 00 0D	CAL_PRS_OFFSET2_FAIL	**Fault:** The second offset calibration of the INSP pressure transducer failed. **Description**: The offset adjustments of the INSP pressure transducer E2-potentiometers is repeated but with a negative offset (-25 cmH2O or 10 cmH2O with PC1750C) to enable measurement of negative pressures. *Displays on Control panel:* The Tidal Volume display shows the target value: 170 (A/D value for 25 cmH2O). The Exp. Tidal Volume display shows the adjusting transducer value. V*alues displayed is converted from cmH20 to corresponding A/D-value*. **What to do**: Refer to CAL_PRS_OFFSET_FAIL (... 00 0B) above.
		x		285	... 01 1D … Sub data:	CON: DIAG_CAL_PRS_TRANSDUCER_MANVENT_FAILURE	**Fault:** Calibration pressure transducer 4 fails (MAN). **Description**: Refer to information regarding “Calibrating pressure transducers” in chapter “Service procedures”, section “Calibration”. CON is responsible for calibration of this transducer.
					... 00 0A	CAL_PRS_OFFSET_INIT_FAIL	**Fault**: Failed to write data to the MAN pressure transducer E2-potentiomerter memory. **Description**: CON is responsible for communication and initiating the MAN pressure transducers E2-potentiometer over the I2C bus. **What to do:** 1. Replace PC 1750 Transducer. 2. Replace PC 1730 Control.
					... 00 0B	CAL_PRS_OFFSET_FAIL	**Fault**: The first offset calibration of the MAN pressure transducer failed. **Description**: The system pressure is zero during offset calibration of the MAN pressure transducer E2-potentiometer. The MAN pressure transducers E2-potentiometers are adjusted during calibration until the transducer value is close to zero. The timeout for calibration is 64 attempts or 30 seconds to adjust MAN pressure transducers E2-potentiometers. *Displays on Control panel:* The Fresh Gas Flow display shows the pressure measured by the INSP pressure transducer until a stable pressure is reached. The Preset O2 Conc. display shows the pressure measured by the EXP pressure transducer until a stable pressure is reached. The Minute Volume display shows the pressure measured by the PEEP pressure transducer until a stable pressure is reached. The Tidal Volume display shows the target value: 0 The Exp. Tidal Volume display shows the adjusting transducer value in 1/100 cmH2O **What to do:** 1. Replace PC 1750 Transducer. 2. Replace PC 1730 Control.
					... 00 0C	CAL_PRS_OFFSET2_INIT_FAIL	Refer to CAL_PRS_OFFSET_INIT_FAIL (... 00 0A) above.

					... 00 0D	CAL_PRS_OFFSET2_FAIL	**Fault**: The second offset calibration of the MAN pressure transducer failed. **Description**: The offset adjustments of the MAN pressure transducer E2-potentiometers is repeated but with a negative offset (-25 cmH2O or -10 cmH2O with PC1750C) to enable measurement of negative pressures. *Displays on Control panel:* The Fresh Gas Flow digit display shows the pressure measured by the INSP pressure transducer until a stable pressure is reached. The Preset O2 Conc. digit display shows the pressure measured by the EXP pressure transducer until a stable pressure is reached. The Minute Volume display shows the pressure measured by the PEEP. pressure transducer until a stable pressure is reached. The Tidal Volume display shows the target value: 2500 (1000 with PC 1750C). The Exp. Tidal Volume display shows the adjusting transducer value. **What to do:** Refer to CAL_PRS_OFFSET_INIT_FAIL (... 00 0A) above.
					... 00 0E	CAL_PRS_GAIN_INIT_FAIL	Refer to CAL_PRS_OFFSET_INIT_FAIL (... 00 0A) above.
					... 00 0F	CAL_PRS_GAIN_FAIL	**Fault**: The gain calibration of the MAN pressure transducer failed. **Description**: The drive gas regulates a stable pressure of first 17 cmH2O and then to 20 cmH2O, with the already calibrated PEEP pressure transducer as reference, during the gain calibration of the MAN pressure transducer. The MAN pressure transducers E2-potentiometers are adjusted during calibration until transducer value is close to the system pressure. The timeout for calibration is 64 attempts or 30 seconds to adjust MAN pressure transducers E2-potentiometers. *Displays on Control panel:* The Fresh Gas Flow digit display shows the pressure measured by the INSP pressure transducer until a stable pressure is reached. The Preset O2 Conc. digit display shows the pressure measured by the EXP pressure transducer until a stable pressure is reached. The Minute Volume display shows the pressure measured by the PEEP pressure transducer until a stable pressure is reached. The Tidal Volume display shows the reached stable system pressure (target value). The Exp. Tidal Volume display shows the adjusting transducer value in 1/100 cmH2O **What to do:** 1. Check / replace manual breathing bag. 2. Replace PC 1750 Transducer alt. PC 1781 (MAN). 3. Replace PC 1730 Control. 4. Replace Drive gas module.
		x		286	... 01 1E … Sub data:	CON: DIAG_CAL_PRS_TRANSDUCER_STABLE_PRS_FAILURE	**Fault**: Stable pressure in the system is not reached when calibrating the pressure transducers. **Description**: Refer to information regarding “Calibrating pressure transducers” in chapter “Service procedures”, section “Calibration”.

					... 00 02	NOT_STABLE_PRESS_TO_FULFILL_MANBAG_OFFSET_CAL_1	The PEEP pressure is not within -1 cmH2O to 0.5 cmH2O as required to fulfill the first offset calibration of the MAN pressure transducer. Stable Pressure is assumed when pressure is within -1 cmH2O to 0.5 cmH2O during 4 seconds. The timeout to reach stable pressure is 30 seconds. *Displays on Control panel:* The Fresh Gas Flow display shows the pressure measured by the INSP pressure transducer until a stable pressure is reached. The Preset O2 Conc. display shows the pressure measured by the EXP pressure transducer until a stable pressure is reached. The Minute Volume display shows the pressure measured by the PEEP pressure transducer until a stable pressure is reached. **What to do:** Check that the Manual breathing bag is deflated and not squeezed during calibration.
					... 00 07	NOT_STABLE_PRESS_TO_FULFILL_MANBAG_GAIN_CAL1	The PEEPpressure is not within 16 cmH2O – 37 cmH2O as required to fulfill the first gain calibration of the MAN pressure transducer. Stable Pressure is assumed when pressure is within 16 cmH2O to 37 cmH2O during 4 seconds. The timeout to reach stable pressure is 30 seconds. *Displays on Control panel:* Refer to (... 00 02) above. **What to do:** The manual breathing bag may be too stiff or too elastic. Replace the Manual breathing bag.
					... 00 09	NOT_STABLE_PRESS_TO_FULFILL_MANBAG_GAIN_CAL2	The PEEP pressure is not within 19 cmH2O – 40 cmH2O as required to fulfill the second gain calibration of the MAN pressure transducer. Stable Pressure is assumed when pressure is within 19 cmH2O to 40 cmH2O during 4 seconds. The timeout to reach stable pressure is 30 seconds *Displays on Control panel:* Refer to (... 00 02) above. **What to do:** The manual breathing bag may be too stiff or too elastic. Replace the Manual breathing bag.
					... 00 0D	NOT_STABLE_PRESS_TO_FULFILL_MANBAG_OFFSET_CAL_2	The PEEP pressure is not within -1 cmH2O – 0.3 cmH2O as required to fulfill the second offset calibration of the **MAN** pressure transducer. Stable Pressure is assumed when pressure is within -1 cmH2O to 0.3 cmH2O during 4 seconds. The timeout to reach stable pressure is 30 seconds. *Displays on Control panel:* Refer to (... 00 02) above. **What to do:** Check that the Manual breathing bag is deflated and not squeezed during calibration.

					... 00 13	NOT_STABLE_PRESS_TO_FULFILL_EXP_INSP_GAIN_CAL_1	The PEEP pressure is not stable enough to fulfill the first gain calibration of the EXP and INSP pressure transducer. The pressure should be 6/7 x target value. The target value is the calibration pressure set with the Fresh Gas Flow knob and measured with the calibration manometer (40 – 50 cmH2O). The following criteria for stable pressure is not fulfilled: [(6/7 x target value) -1 cmH2O] < PEEP < [(6/7 x target value) + 10 cmH2O] Stable Pressure is assumed when pressure criteria is fulfilled during 4 seconds. The timeout to reach stable pressure is 30 seconds *Displays on Control panel:* Refer to (... 00 02) above. **What to do:** Replace the Drive gas module.
					... 00 15	NOT_STABLE_PRESS_TO_FULFILL_EXP_INSP_GAIN_CAL_2	The PEEP pressure is not stable enough to fulfill the second gain calibration of the **EXP** and **INSP** pressure transducers. The pressure should be the target value. The target value is the calibration pressure set with the Fresh Gas Flow knob and measured with the calibration manometer (40 – 50 cmH2O). The following criteria for stable pressure is not fulfilled: Target value -1 cmH2O < PEEP < target value + 10 cmH2O Stable Pressure is assumed when pressure criteria is fulfilled during 4 seconds. The timeout to reach stable pressure is 30 seconds *Displays on Control panel:* Refer to (... 00 02) above. **What to do:** Replace the Drive gas module.
		x		287	... 01 1F …	CON: DIAG_CAL_BAROMETER_FAILURE	**Fault**: Checking barometer failed during Calibration. PAN is responsible for calibration of this transducer. **Description**: Refer to information regarding “Checking barometer” in chapter “Service procedures”, section “Calibration”. The operator is demanded to adjust barometer value (if necessary) using the Fresh Gas Flow knob to enter a new value. The calibration fails if user have entered a value greater than 1150 mbar or the barometer cannot be adjusted correctly. *Displays on Control panel:* The Tidal Volume display shows the actual measured barometric pressure. **What to do:** Replace PC 1672 Control Panel
		x		288	... 01 20 Sub data: ... AB CD	CON: DIAG_CAL_UPPER_PRS_LIMIT_NOT_SET UPPER_PRESSURE_LIMIT_SETTING	**Fault**: The UPL knob is not correctly set when starting Calibration. **Description**: Refer to information regarding “Check of control panel settings and of gas supply” in chapter “Service procedures”, section “Calibration”. The Calibration starts with a check that the UPL is set between 60-80 cmH2O. **What to do**: 1. Set the UPL knob to 70 cmH2O 2. Check/replace UPL control panel potentiometer. The knob may be incorrectly mounted on the potentiometer shaft. Shows the UPL knob setting (1/100 cmH2O) in hexadecimal form .

			x	295	... 01 27 …	CON: DIAG_EMERGENCY_TOO_LONG_INSP_PRS	**Fault**: The system is not evacuated within 2 seconds when a high pressure emergency situation occurred. **Description:** The measured INSP pressure when the emergency situation occurred can be read in sub data. **What to do**: 1. Check that EVAC system is not blocked. 2. Redo a PuC to check that MV2 and PEEP valve works properly. 3. Perform a Calibration 4. Report to EM-HSC.
					Sub data:		
					... AB CD	INSP_TRANSDUCER_PRESSURE	Shows the measured pressure (1/10 cmH2O) for the INSP pressure transducer in hexadecimal.
			x	296	... 01 28 …	CON: DIAG_EMERGENCY_TOO_LONG_EXP_PRS	**Fault**: The system is not evacuated within 2 seconds when a high pressure emergency situation occurred. **Description:** The measured EXP pressure when the emergency situation occurred can be read in sub data. **What to do**: 1. Check that EVAC system is not blocked. 2. Redo a PuC to check that MV2 and PEEP valve works properly. 3. Perform a Calibration 4. Report to EM-HSC.
					Sub data:		
					... AB CD	EXP_TRANSDUCER_PRESSURE	Shows the measured pressure (1/10 cmH2O) for the EXP pressure transducer in hexadecimal.
			x	297	... 01 29 …	CON: DIAG_EMERGENCY_TOO_LONG_ISYN	**Fault**: The system is not evacuated within 2 seconds when a high pressure emergency situation occurred. **Description:** Three consecutive diagnostic logs. The first log shows the pressure measured on the EXP pressure transducer, the second shows the INSP transducer and the third shows the UPL knob setting. Refer to sub data. **What to do**: 1. Check that EVAC system is not blocked. 2. Redo a PuC to check that MV2 and PEEP valve works properly. 3. Perform a Calibration 4. Report to EM-HSC.
					Sub data:		
					... AB CD	EXP_TRANSDUCER_PRESSURE	Shows the measured pressure (1/10 cmH2O) for the EXP pressure transducer in hexadecimal.
						INSP_TRANSDUCER_PRESSURE	Shows the measured pressure (1/10 cmH2O) for the INSP pressure transducer in hexadecimal.
						UPPER_PRESSURE_LIMIT_SETTING	Shows UPL knob setting (1/10 cmH2O) in hexadecimal.

x 100				301	... 01 2D ...	PAN: DIAG_STARTUP_CPU_TEST_FAILED	**Fault:** Hardware failure. **Description:** CPU fails during startup hardware test. **What to do**: Replace PC 1672 Control Panel
x 100				302	... 01 2E ...	PAN: DIAG_STARTUP_ROM_TEST_FAILED	**Fault:** Hardware failure. **Description:** ROM fails during startup hardware test. **What to do**: Replace PC 1672 Control Panel.
x 100				303	... 01 2F ...	PAN: DIAG_STARTUP_RAM_TEST_FAILED	**Fault:** Hardware failure. **Description:** RAM fails during startup hardware test. **What to do**: Replace PC 1672 Control Panel.
x 100				304	... 01 30 ...	PAN: DIAG_STARTUP_WATCHDOG_TEST_FAILED	**Fault:** Hardware failure. **Description:** Watchdog fails during startup hardware test. **What to do**: Replace PC 1672 Control Panel.
x 100				305	... 01 31 ...	PAN: DIAG_STARTUP_TIMER_TEST_FAILED	**Fault:** Hardware failure. **Description:** Timer fails during startup hardware test. **What to do**: Replace PC 1672 Control Panel.
x 100				306	... 01 32 ...	PAN: DIAG_STARTUP_RESET_OCCURED	**Fault:** Hardware failure. **Description:** Reset occurred during the startup hardware test. **What to do**: 1. Check +5V power supply to PC 1672 Control Panel 2. Replace PC 1672 Control Panel.
x 100				307	... 01 33 ...	PAN: DIAG_STARTUP_LED_TEST_FAILED Display-error	**Fault:** Hardware failure (display-error). **Description:** One of the Control panel LEDs fails during the startup hardware test. **What to do**: Replace PC 1672 Control Panel.
			x	309	… 01 35 …	PAN: CAN_ERROR_BUFFER_FULL	**Fault:** Communication bus (CAN) is not working properly. **Description:** The circular CAN receive buffer is full, at least one CAN-message is missed. Circular buffer holds 10 CAN-messages. **What to do**: 1. If this log is repeted several times; check CAN communicating units, i.e. microprocessor controlled PC boards, multigas analyzer, KION Monitor and DuoView. Also check PC board- and cable connectors. 2. Report to EM-HSC.
			x	310	… 01 36 …	PAN: DIAG_CAN_DATA_OVERRUN	**Fault:** Communication bus (CAN) is not working properly. **Description:** Data overrun has occurred, at least one CAN-message is missed. **What to do**: 1. If this log is repeted several times; check CAN communicating units, i.e. microprocessor controlled PC boards, multigas analyzer, KION Monitor and DuoView. Also check PC board- and cable connectors. 2. Report to EM-HSC.

			x	312	… 01 38 …	PAN: DIAG_CAN_SEND_TIMEOUT	**Fault:** Communication bus (CAN) is not working properly. **Description:** The CAN driver reports a send timeout error. **What to do**: 1. Replace PC 1672 Control Panel. 2. If this log is repeted several times; check CAN communicating units, i.e. microprocessor controlled PC boards, multigas analyzer, KION Monitor and DuoView. Also check PC board- and cable connectors. 3. Report to EM-HSC.
			x	313	… 01 39 …	PAN: DIAG_CAN_WARNING_LIMIT_REACHED	**Fault:** Communication bus (CAN) is not working properly. **Description:** At least one error counter has reached warning limit. Refer to diagnostic log 314. **What to do**: 1. If this log is repeted several times; check CAN communicating units, i.e. microprocessor controlled PC boards, multigas analyzer, KION Monitor and DuoView. Also check PC board- and cable connectors. 2. Report to EM-HSC.
			x	314		PAN: DIAG_CAN_WARNING_LIMIT_OK_AGAIN	**Information:** Communication bus (CAN) is working again. **Description:** At least one error counter has reached warning limit. The problem is solved by the HW. Refer to diagnostic log 313.
x 100				320	… 01 40 …	PAN: DIAG_SETTING_VOLUME_ALARM_LIMIT_ERROR	**Fault:** The Lower Vol. Alarm Limit potentiometer is not working properly. **Description:** The reading of the potentiometer failed. **What to do**: 1. Check / replace potentiometer. 2. Replace PC 1672 Control Panel.
x 100				323	… 01 43 …	PAN: DIAG_SETTING_HIGH_PRESSURE_LIMIT_ERROR	**Fault:** The Upper Pressure Limit potentiometer is not working properly. **Description:** The reading of the potentiometer failed. **What to do**: 1. Check / replace potentiometer 2. Replace PC 1672 Control Panel.
x 100				329	… 01 49 …	PAN: DIAG_SETTING_BAROMETER_PRESSURE_ERROR	**Fault:** The Barometer is not working properly. **Description:** The reading of the barometer failed or the read value is out of range (600 < Barometer Pressure < 1150). **What to do**: Replace PC 1672 Control Panel.

x 100				331	… 01 4B …	PAN: DIAG_ALARM_SUBSYSTEM_NOT_RESPONDING	**Fault:** ALA is not responding. **Description:** PAN is continuously sending a STATUS_REQUEST message to ALA and waits for the acknowledge STATUS_REPLY message. This message is not received within 2 seconds. **What to do**: 1. Check / replace the ALA-PROM. 2. Replace PC 1672 Control Panel.
x 100				332	… 01 4C …	PAN: DIAG_PANEL_INITIATION_FAILED	**Fault:** Panel initialization failed. **Description:** Failed to set up timers when PAN processor starts. **What to do**: Replace PC 1672 Control Panel.
			x	333	... 01 4D ...	PAN: DIAG_SW_ERROR	**Fault:** The CAN message to send do not follow the protocol. **Description:** An illegal length, priority or node address for the CAN message is detected **What to do**: 1. If repeated several times; replace PC 1672 Control Panel. 2. Report to EM-HSC.
x 100				401	… 01 91 …	MEA: DIAG_CPU_ERROR	**Fault:** Hardware failure. **Description:** CPU is not working properly during startup hardware test. **What to do**: Replace PC 1737 Measuring.
x 100				402	… 01 92 …	MEA: DIAG_ROM_ERROR	**Fault:** Hardware failure. **Description:** ROM is not working properly during startup hardware test. **What to do**: Replace PC 1737 Measuring.
x 100				403	… 01 93 …	MEA: DIAG_RAM_ERROR	**Fault:** Hardware failure. **Description:** RAM is not working properly during startup hardware test. **What to do**: Replace PC 1737 Measuring.
x 100				404	… 01 94 …	MEA: DIAG_WD_ERROR	**Fault:** Hardware failure. **Description:** Watchdog is not working properly during startup hardware test. **What to do**: Replace PC 1737 Measuring.
x 100				405	… 01 95 …	MEA: DIAG_TIMER_ERROR	**Fault:** Hardware failure. **Description:** Timer is not working properly during startup hardware test. **What to do**: Replace PC 1737 Measuring.
			x	407	... 01 97 ...	MEA: DIAG_CAN_BUS_OFF	**Fault:** Hardware failure. **Description:** The CAN bus is in OFF state. The software tries to restart the bus until the watchdog resets the processor. Refer to diagnostic log 408. **What to do**: If repeted, replace PC 1737 Measuring.
			x	408	... 01 98 ...	MEA: DIAG_CAN_BUS_OFF_SOLVED	**Information:** Hardware failure has been solved. Refer to diagnostic log 407. **Description:** The CAN bus has been in OFF state but has restarted again.

			x	409	... 01 99 ...	MEA: DIAG_CAN_BUFFER_FULL	**Fault:** Communication bus (CAN) is not working properly. **Description:** The circular CAN receive buffer is full, at least one CAN-message is missed. Circular buffer holds 10 CAN-messages. **What to do**: 1. If this log is repeted several times; check CAN communicating units, i.e. microprocessor controlled PC boards, multigas analyzer, KION Monitor and DuoView. Also check PC board- and cable connectors. 2. Report to EM-HSC.
			x	410	... 01 9A ...	MEA: DIAG_CAN_DATA_OVERRUN	**Fault:** Communication bus (CAN) is not working properly. **Description:** Data overrun has occurred, at least one CAN-message is missed. **What to do**: 1. If this log is repeted several times; check CAN communicating units, i.e. microprocessor controlled PC boards, multigas analyzer, KION Monitor and DuoView. Also check PC board- and cable connectors. 2. Report to EM-HSC.
			x	412	... 01 9C ...	MEA: DIAG_CAN_TIMEOUT	**Fault:** Communication bus (CAN) is not working properly. **Description:** The CAN driver reports a send timeout error. **What to do**: 1. Replace PC 1737 Measuring. 2. If this log is repeted several times; check CAN communicating units, i.e. microprocessor controlled PC boards, multigas analyzer, KION Monitor and DuoView. Also check PC board- and cable connectors. 3. Report to EM-HSC.
			x	413	... 01 9D ...	MEA: DIAG_CAN_WARNING_LIMIT_REACHED	**Fault:** Communication bus (CAN) is not working properly. **Description:** At least one error counter has reached warning limit. **What to do**: 1. If this log is repeted several times; check CAN communicating units, i.e. microprocessor controlled PC boards, multigas analyzer, KION Monitor and DuoView. Also check PC board- and cable connectors. 2. Report to EM-HSC.
			x	415	... 01 9F ...	MEA: DIAG_UNKNOWN_CAN_MESSAGE	**Fault:** Internal program error e.g. due to incompatible sub-system SW-versions. **Description:** Unknown CAN-message is received from an other sub-system. **What to do**: 3. Check sub-system SW-compatibility. Refer to KION Compatibility Chart. 4. Report to EM-HSC.
			x	416	... 01 A0 ...	MEA: DIAG_AD_ERROR_SINGLE_FAULT	**Fault:** Hardware failure. **Description:** Failure to read A/D-port once. **What to do**: Replace PC 1737 Measuring.

			x	417	... 01 A1 ...	MEA: DIAG_AD_ERROR_DOUBLE_FAULT	**Fault:** Hardware failure. **Description:** Failure to read A/D-port twice. **What to do**: Replace PC 1737 Measuring.
			x	419	... 01 A3 ...	MEA: DIAG_INTERNAL_ERROR	**Fault:** Internal program failure. **Description:** Diagnostic log regarding faulty states in MEA software. **What to do**: 1. Replace PC 1737 Measuring. 2. Report to EM-HSC.
			x	420	... 01 A4 ...	MEA: DIAG_NO_DATA_FROM_MGM	**Fault:** The CAN/RS232 interface reports an error. **Description:** The multigas analyzer is not reporting concentration data as presumed. **Note**: This diagnostic log may appear now and then, but will impact functionality only if repeted several times in a row. **What to do** (Only if repeted): 1. Check if the multigas analyzer is displaying concentration values correctly on the KION Monitor. 2. Troubleshoot the multigas analyzer: – Function check. – Calibration. – Multigas analyzer service software.
x 100				421	… 01 A5 …	MEA: DIAG_NO_INSP_SIGNAL_FROM_CON	**Fault:** No INSP or EXP signal is received from CON. **Description:** The signal informing that a new expiration or inspiration has started has not been received from the CON within 30 seconds. This diagnostic log can only come in controlled ventilation modes. **What to do:** 1. Replace PC 1737 Measuring. 2. Replace PC 1730 Control. 3. Report to EM-HSC.
x 560			x	601	… 02 59 …	MGI: DIAG_CPU_ERROR	**Fault:** Hardware failure. **Description:** CPU is not working properly during startup hardware test. Alarm 560 is generated. **What to do**: Replace PC 1747 CAN/RS232 Interface.
x 560			x	602	… 02 5A …	MGI: DIAG_ROM_ERROR	**Fault:** Hardware failure. **Description:** ROM is not working properly during startup hardware test. Alarm 560 is generated. **What to do**: Replace PC 1747 CAN/RS232 Interface.
x 560			x	603	… 02 5B …	MGI: DIAG_RAM_ERROR	**Fault:** Hardware failure. **Description:** RAM is not working properly during startup hardware test. Alarm 560 is generated. **What to do**: Replace PC 1747 CAN/RS232 Interface.

			x	604	... 02 5C ...	MGI: DIAG_CHECKSUM_ERROR	**Fault:** Checksum error in response message. **Description**: The checksum in received message from multigas analyzer is not correct. **What to do**: 1. Communication error between the multigas analyzer and PC 1747. Check RS232 cable and connectors. 2. Troubleshoot the multigas analyzer. 3. Replace PC 1747 CAN/RS232 Interface.
x 562			x	605	… 02 5D …	MGI: DIAG_O2_MODULE_ERROR	**Fault:** Hardware failure **Description:** Status command is received from multigas analyzer informing that persistent O2 data is invalid and the O2 cell is not working properly. Alarm 562 is generated. **What to do**: Troubleshoot the multigas analyzer.
x 960			x	606	... 02 5E ...	MGI: DIAG_COMMAND_TIMEOUT_ERROR	**Fault:** The multigas analyzer has not acknowledge command. **Description:** No command response is received from the multigas analyzer within 70 ms. Alarm 960 is generated. **What to do**: 1. Communication error between the multigas analyzer and PC 1747. Check RS232 cable and connectors. 2. Troubleshoot the multigas analyzer.
			x	607	... 02 5F ...	MGI: DIAG_CONTINUOUS_DATA_TIMEOUT_ERROR	**Fault:** The multigas analyzer has stopped sending waveform data. **Description:** No waveform data is received from the multigas analyzer within 60 ms. The multigas analyzer should send waveform data with 25 Hz. **What to do**: 1. Communication error between the multigas analyzer and PC 1747. Check RS232 cable and connectors. 2. Troubleshoot the multigas analyzer.
x 960			x	608	... 02 60 ...	MGI: DIAG_STATUS_TIMEOUT_ERROR	**Fault:** The multigas analyzer has stopped sending status information data. **Description:** No status information data is received from the multigas analyzer within 1.5 seconds. The multigas analyzer should send status information with 1 Hz. Alarm 960 is generated. **What to do**: 1. Communication error between the multigas analyzer and PC 1747. Check RS232 cable and connectors. 2. Troubleshoot the multigas analyzer.

			x	609	... 02 61 ...	MGI: DIAG_PATIENT_DATA_TIMEOUT_ERROR	**Fault:** The multigas analyzer has stopped sending patient data. **Description:** No patient data is received from the multigas analyzer within 1.5 seconds. The multigas analyzer should send patient data with 1 Hz. **What to do**: 1. Communication error between the multigas analyzer and PC 1747. Check RS232 cable and connectors. 2. Troubleshoot the multigas analyzer.
x 560			x	611	… 02 63 …	MGI: DIAG_TIMER_ERROR	**Fault:** Hardware failure. **Description:** Timer is not working properly during startup hardware test. Alarm 560 is generated. **What to do**: Replace PC 1747 CAN/RS232 Interface.
x 560			x	612	… 02 64 …	MGI: DIAG_WD_ERROR	**Fault:** Hardware failure. **Description:** Watchdog is not working properly during startup hardware test. Alarm 560 is generated. **What to do**: Replace PC 1747 CAN/RS232 Interface.
			x	613	… 02 65 …	MGI: DIAG_RESTART_ERROR	**Fault:** Hardware failure. **Description:** The COLD_START_FLAG is not set during startup hardware test. **What to do**: Replace PC 1747 CAN/RS232 Interface.

Notes

Only personnel trained and authorized by Siemens shall be permitted to perform installation, service or maintenance of the KION / KION-i workstation.

Make sure to prepare the KION / KION-i workstation properly before disassembling and assembling. Refer to section "Hazard notices" in chapter "Important".

Any service or maintenance must be noted in a log book.

Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

After any installation, maintenance or service intervention in the KION / KION-i, perform a "Calibration" and a "Function check".
Refer to the "KION / KION-i anesthesia workstation – Operating Manual" for details.

7. Maintenance

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General

- Only personnel trained and authorized by Siemens shall be permitted to perform installation, service or maintenance of the KION / KION-i workstation.
- A "Twelve months maintenance" must be performed every twelve months or every 3000 hours of operation whichever comes first. Any service or maintenance must be noted in the log book.
- After or in combination with performing the "Twelve months maintenance" described in this chapter, a routine cleaning must be performed. Refer to chapter "Routine cleaning" in the "KION / KION-i – Operating Manual" for details.
- The internal battery, and the extra internal battery if fitted, shall be replaced every three years.
- Some equipment used in the KION / KION-i workstation, but not covered by this Service Manual, may also demand maintenance actions. Refer to the equipments documentation. These units can e. g. be:
  - Multigas analyzer
  - KION Monitor including its optional equipment
  - DuoView
  - Suction equipment
  - Auxiliary O_2 supply
  - Gas evacuation
  - Humidifier equipment
  - Other optional equipment.

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Preparations

- Make sure that the KION / KION-i workstation works properly before performing any maintenance.
- Disconnect the gas supplies (wall and/or tank).
- Disconnect the mains power cable.
- Set the power switch on the control panel to **Off**. If the power switch is set in any other position, the internal battery will supply power to the PC boards.
- Remove patient tubing (incl. gas sampling tube and water trap) and the manual breathing bag.
- If fitted, remove bacteria filter(s) from the patient cassette.

Required equipment

- Standard service tools.
- 24 mm socket wrench.
- Pressure Tester 0.2 bar Regulator (REG1). P/N 65 62 479 E392E.
- Support plate adjustment tool. P/N 66 37 529 E392E.
- Grease, P/N 95 73 700 E341E. Special grease to be used in high O_2 concentrations.
- Loctite® 243.

Handling PC boards

KION workstations delivered before July 1998 are not equipped with the protective plate covering the PC boards inside the pneumatic section. Avoid contact with these PC boards when performing maintenance inside the pneumatic section.

The PC boards contain components that are highly sensitive to static electricity.

Those who come into contact with circuit boards containing sensitive components must take certain precautions to avoid damaging the components (ESD protection).

When working with ESD sensitive components, always use a grounded wrist band and grounded work surface. Adequate service tools must also be used.

PC boards (spare parts) must always be kept in protective packaging for sensitive electronic devices.

PC boards must not be inserted or removed while mains power or battery power is applied to the PC boards.

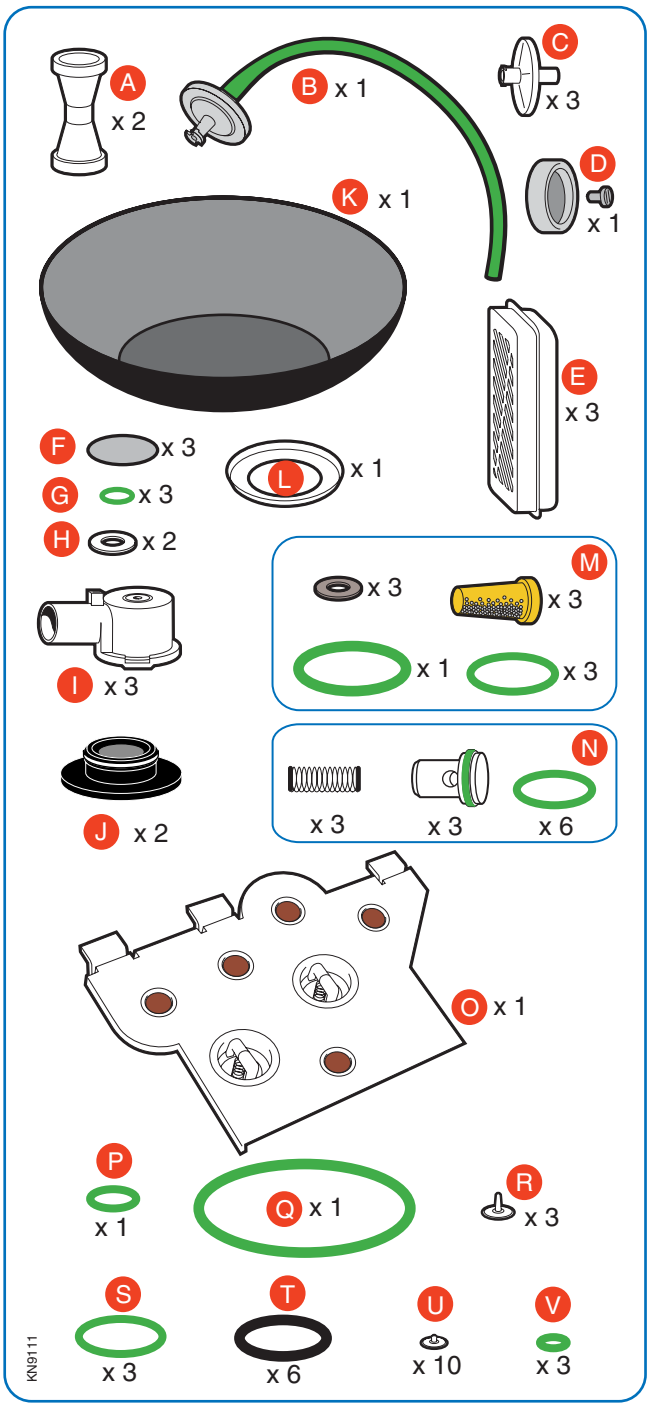
Remove and insert the PC boards very carefully to avoid damage to the connectors.

Twelve months maintenance

Maintenance kit contents

When performing the "Twelve months maintenance", a "Maintenance kit 12 months for KION" should be used.

Only original parts from Siemens-Elema must be used in the KION / KION-i workstation. Spare parts and maintenance kits can be ordered from your local Siemens representative.



The following parts shall be replaced and they are included in the "Maintenance kit 12 months for KION":

A. Fresh gas valve tube and PEEP valve tube.
B. Bacteria filter with tube for the PEEP pressure transducer.
C. Bacteria filters for the silicone muff in the patient cassette docking station.
D. Expiratory flow transducer screen (mesh net) including screw.
E. Filters for the gas modules.
F. Diaphragms for gas modules with metal nozzle unit (Gas modules Type I).
G. O-rings 6.1 x 1.6 for gas modules with metal nozzle unit (Gas modules Type I).
H. Washers for gas modules with metal nozzle unit (BP gas modules Type I).
I. Plastic nozzle units (Gas modules Type II).
J. Cuffs for the Inspiratory gas block.
K. Diaphragm for the fresh gas pressure container.
L. Piston seal for the fresh gas pressure container.
M. Gas inlet filter kit for the Gas distribution block containing:
   - Gas inlet filters
   - Gaskets for the gas inlet filters
   - O-rings 15.3 x 2.4 for the gas distribution block
   - O-ring 19.2 x 3 for the gas distribution block.
N. Valve kit for the Gas distribution block containing:
   - Valve plunges with O-rings
   - Valve springs
   - O-rings 12.1 x 1.6 for the valve housing.
O. Valve assembly plate for the patient cassette.
P. O-ring 9.3 x 2.4 for the vaporizer magazine.
Q. O-ring 36.2 x 3.0 for the vaporizer magazine.
R. One-way valves for the vaporizer magazine inlet connectors.
S. O-rings 14.1 x 1.6 for the vaporizer magazine inlet connectors.
T. O-rings 14 x 3 for the vaporizer magazine inlet and outlet connectors.
U. Screw covers for the vaporizer magazine.
V. O-rings 5.3 x 2.4 for the vaporizer valve.

Backup gas supply manifold maintenance

If the KION / KION-i workstation is equipped with a Backup gas supply manifold, a spare parts kit containing 4 gas inlet filters is required during the "Twelve months maintenance". The seals at the gas cylinder connection must also be replaced.

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Performing the Twelve-months maintenance

- Disassembling and assembling of the workstation is required when replacing parts included in the ”Maintenance kit 12 months for KION”. If not stated otherwise, refer to chapter "Disassembling and assembling" for instructions.
- The letters A – V in the text below refers to the description of the Maintenance kit on page 7 - 3.
- Prepare the unit as described in section ”Preparations” above in this chapter.

Six-months maintenance

The Six-months maintenance is a part of the Twelve-months maintenance. Perform as described in the ”KION / KION-i – Operating Manual”, chapter "Six-months maintenance".

Replace:

A. Fresh gas valve tube and PEEP valve tube.
B. Bacteria filter with tube for the PEEP pressure transducer.
C. Bacteria filters for the silicone muff in the patient cassette docking station.
D. Expiratory flow transducer screen (mesh net) including screw.

Clean the following parts before assembling:

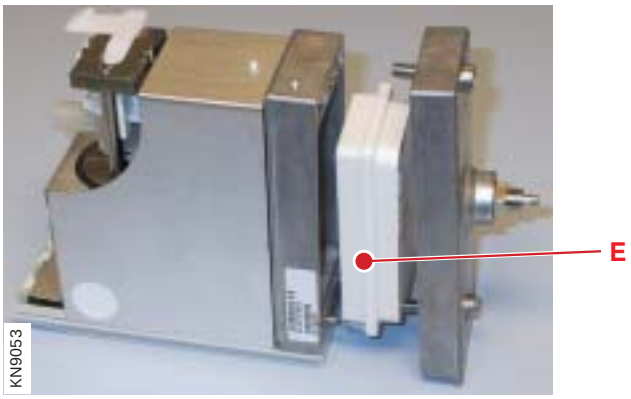
- Fresh gas valve tube and PEEP valve tube
- Fresh gas flow transducer and Expiratory flow transducer.
- Silicone rubber connections for the Fresh gas flow transducer.
- Exhaust gas hose connected between the PEEP valve and the EVAC outlet.

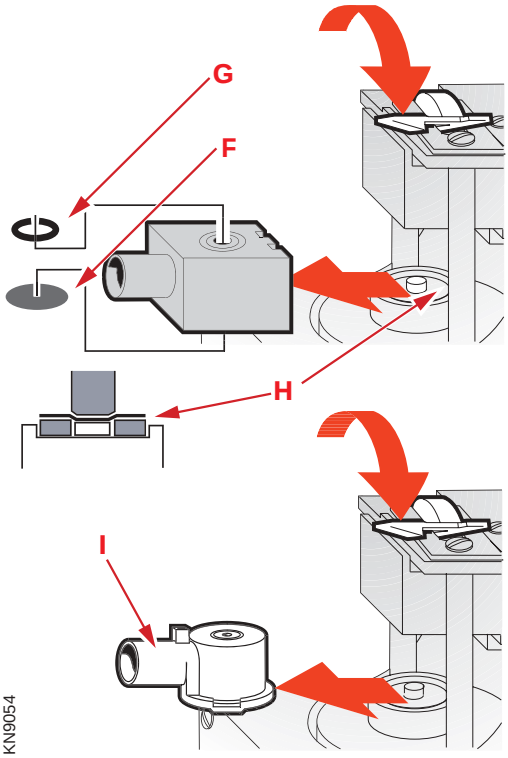
For cleaning instructions, refer to the ”KION / KION-i – Operating Manual”, chapter "Routine cleaning".

Gas modules

Replace:

E. Filters in the gas modules. When replacing filter, move the rubber seal from the old to the new filter.





F. Diaphragms for gas modules with metal nozzle unit (Gas modules Type I).
G. O-rings 6.1 x 1.6 for gas modules with metal nozzle unit (Gas modules Type I).
H. Washers for gas modules with metal nozzle unit (BP gas modules Type I).

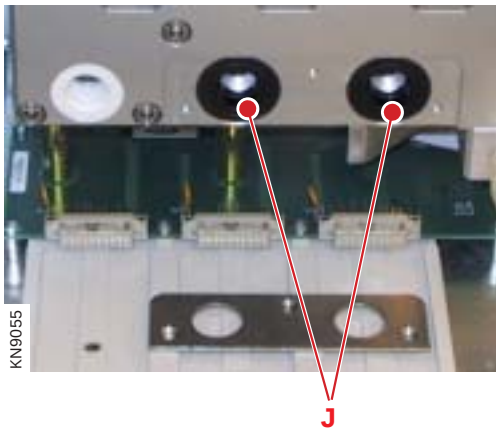
I. Plastic nozzle units (Gas modules Type II).

After replacement of diaphragms or plastic nozzle units, wait 10 minutes before connecting pressure to the gas modules.

Inspiratory gas block

Replace:

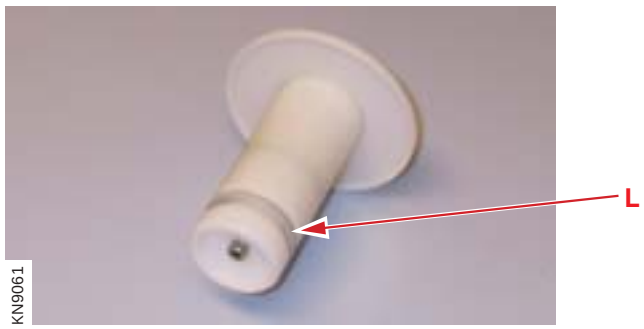
J. Cuffs in the Inspiratory gas block.



Fresh gas pressure container

Replace:

K. Diaphragm in the fresh gas pressure container.
L. Piston seal on the fresh gas pressure container piston.



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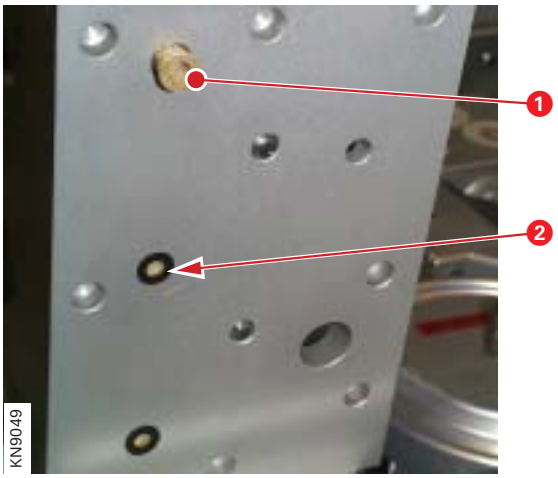
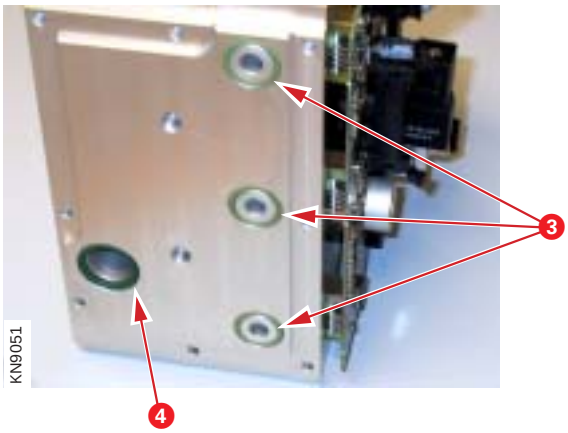
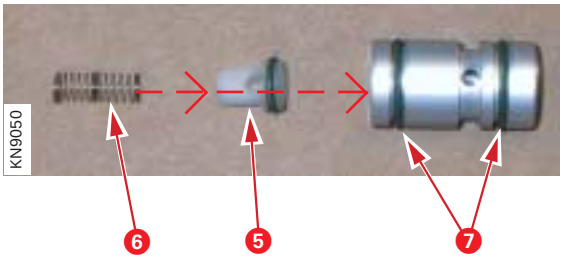
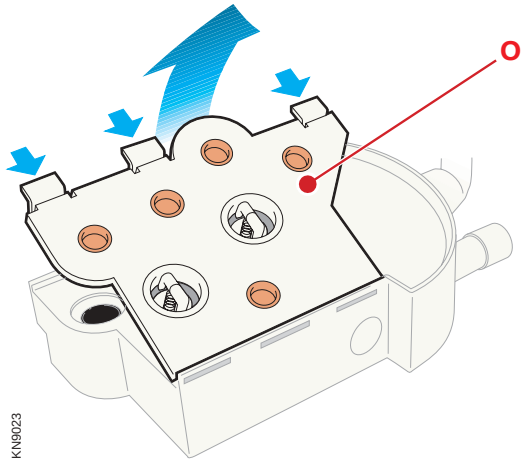








Gas distribution block

Replace:

M. Gas inlet filter kit for the Gas distribution block containing:
   1. Gas inlet filters
   2. Gaskets for the gas inlet filters
   3. O-rings 15.3 x 2.4 for the gas distribution block
   4. O-ring 19.2 x 3 for the gas distribution block.

N. Valve kit for the Gas distribution block containing:
   5. Valve plunges with O-rings
   6. Valve springs
   7. O-rings 12.1 x 1.6 for the valve housing.

Patient cassette

Replace:

O. Valve assembly plate on the patient cassette.

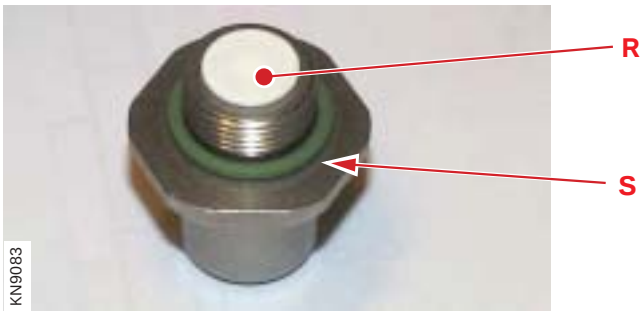
Clean the patient cassette (including the new valve assembly plate and the flow transducer silicone muff) before assembling. For cleaning instructions, refer to the ”KION / KION-i – Operating Manual”, chapter "Routine cleaning".

Vaporizer magazine

Replace:

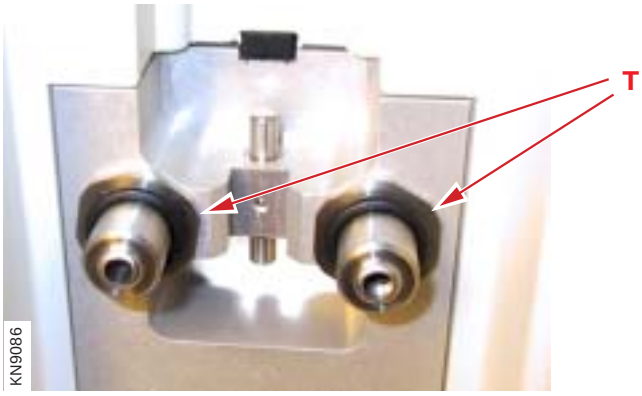
P. O-ring 9.3 x 2.4 for the vaporizer magazine. Apply a thin layer of special grease on the O-ring.

Q. O-ring 36.2 x 3.0 for the vaporizer magazine. Apply a thin layer of special grease on the O-ring.



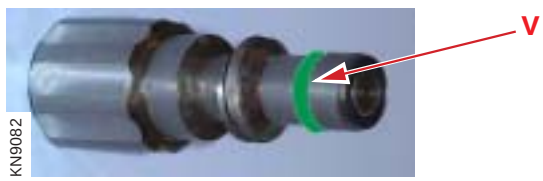
R. One-way valves for the vaporizer magazine inlet connectors.

S. O-rings 14.1 x 1.6 for the vaporizer magazine inlet connectors.



T. O-rings 14 x 3 for the vaporizer magazine inlet and outlet connectors.

U. Screw covers for the vaporizer magazine. Not shown in the illustration.



PIVap vaporizer

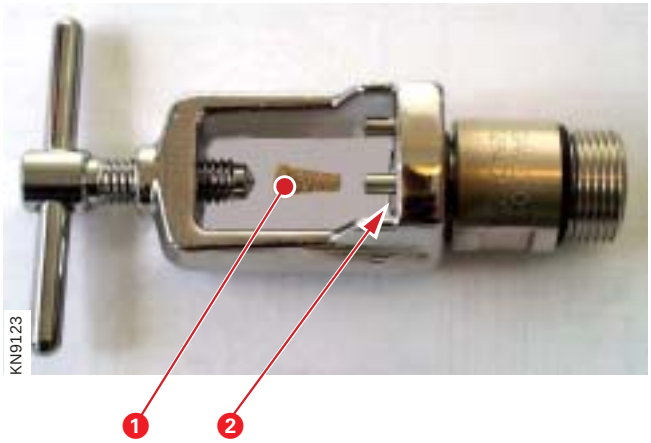
Replace:

V. O-rings 5.3 x 2.4 for the vaporizer valve. Apply a thin layer of special grease on the O-rings.

Replace this O-ring on each one of the vaporizers to be used on the concerned workstation. Three O-rings are included in the kit, order further O-rings if required.

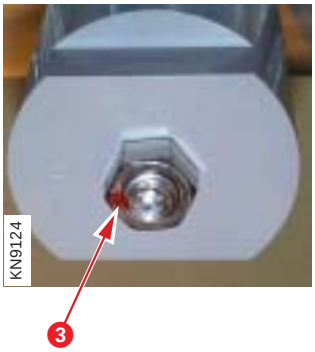
Dust filter

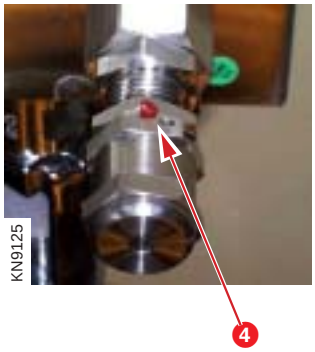
- Check the dust filter (1) inside the trolley cover.
- Clean the dust filter if it is clogged. The dust filter can be rinsed in water. Shake out all remaining water. Make sure that no water remains in the filter.



Backup gas supply manifold

- On all four yokes, replace:
  - Gas inlet filter (1)
  - Seal at the gas cylinder connection (2).





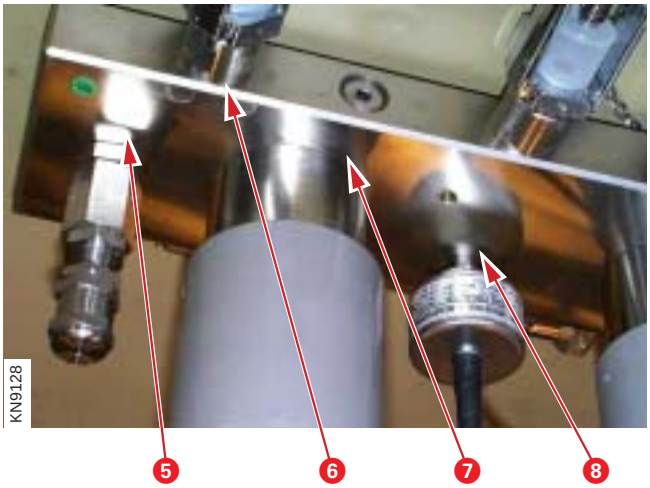
- The pressure regulators and the safety valves are preset to correct settings and secured with a visible drop of sealant. Inspect the pressure regulators and the safety valves:
  - Check that the seals (3) on the pressure regulators are not broken.
  - Check that the seals (4) on the safety valves are not broken.
- If a seal on any of these units is broken, replace this unit.

KN9126

- Connect gas supply (from the hospital central gas supply) to all three gas inlets on the KION / KION-i workstation.
- Check if there is a leakage through the one-way valves (OV5–OV8) in all four yokes. Cover the gas inlet channel in each yoke with a finger and check if there is a pressure built-up under the finger. Replace faulty one-way valves if necessary.
- Disconnect the gas supply.

KN9127

- Connect gas cylinders to the backup gas supply manifold and open the cylinder valves.
- Check if there is a leakage through the safety valves (SV5–SV7). Cover both outlet holes on each one of the safety valves with two fingers and check if there is a pressure built-up under the fingers. Replace faulty safety valves if necessary.



KN9128

- Check for gas leakages (with gas cylinder valves still open). Use leakage detection spray/liquid and check the following connections:
  - The connection between the safety valves and the manifold (5).
  - The connection between the yoke and the manifold (6).
  - The connection between the pressure regulators and the manifold (7).
  - The connection between the pressure transducer and the manifold (8).
- Close the gas cylinder valves.
- If a gas leakage was detected, replace the O-ring/ gasket at the faulty unit and re-check.

KN9129

A function check of the Backup gas supply manifold will be performed as a part of section "Completing the Twelve-months maintenance" below.

- With gas cylinder valves open, check for gas leakages through the gas connections on the Gas distribution block. Cover the gas inlet with a finger and check if there is a pressure built-up under the finger. If necessary, replace faulty one-way valves (OV1–OV3) inside the Gas distribution block.

7

KN9130

Checking pressure regulator REG 1

- Check and if required adjust the Mushroom valve control gas supply pressure delivered by REG 1. The pressure delivered by REG1 should be set to 20 kPa.

For the check and adjustment of REG 1, use to the tool “Pressure Tester 0.2 bar regulator”, P/N 65 62 479. Instructions are enclosed with the tool.

KN9131

Checking support plate for patient cassette

- Check and if required adjust the level of the patient cassette support plate.

For this check and adjustment, use the “Support plate adjustment tool”, P/N 66 37 529. Instructions are enclosed with the tool.

7

Checking the internal battery

- Allow the internal battery to charge until the battery indicator on the KION Monitor shows "*100%*".
- Disconnect mains power to make the KION / KION-i workstation run on the internal battery.
- Let the KION / KION-i workstation run on the internal battery and check the battery alarm is not activated within:
  - 40 minutes if the KION / KION-i workstation is equipped with standard internal battery.
  - 130 minutes if the KION / KION-i workstation is equipped with extra internal battery.
- Allow the internal battery to recharge before clinical use of the KION / KION-i workstation.

Note: To save time, this battery test can be performed during the functional checks described below in section "Completing the Twelve-months maintenance".

Safety inspection

- Make a visual inspection of the KION / KION-i workstation for external defects or damages.
- Check the mains power cable, voltage supply cables and connections for damage.
- Perform a leakage current test. The leakage current test is a standard procedure regulated by IEC 60 601-1 or corresponding national standards. Allowable values and test methods are defined in the standard. The use of a leakage tester, e. g. Bender Safety Tester 601/751 or equivalent is recommended.
- Check that a "KION / KION-i – Operating Manual" corresponding to the installed software version is present. Also check that Operating Manuals for all optional equipment connected to the KION / KION-i workstation are present.

Completing the Twelve-months maintenance

- Perform a check of all vaporizers to be used on the KION / KION-i workstation. For details, refer to the "KION / KION-i – Operating Manual", chapter "Six-month maintenance", section "Checking the vaporizers".
- Perform a "Calibration". Refer to the "KION / KION-i – Operating Manual" for details.
- Perform a "Functional check". Refer to the "KION / KION-i – Operating Manual" for details.
- Perform "Functional checks" on the optional equipments connected to the KION / KION-i workstation. Refer to the Operating Manual for these equipments (Backup gas supply manifold, Auxiliary O_2 supply, Suction equipment, etc).
- Note in the log book that a "Twelve-months maintenance" has been performed.

Replacing the internal battery

The internal battery, and the extra internal battery if fitted, shall be replaced every three years. Batteries (spare parts) are not supplied by Siemens. They must be purchased locally. Tested batteries for use in the KION / KION-i workstation are listed below. No other batteries must be used.

- **CSB EVX-12260** (http://www.csb-battery.com)
- **Newmax FNC 12240** (http://www.newmaxbattery.co.kr)
- **Power-Sonic PS-12260 NB** (http://www.power-sonic.com)
- **Hitachi HP24-12**

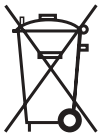
For further information regarding the batteries and battery suppliers, refer to the Internet address stated at each battery type above or to the Siemens Medical Solutions, Customer Service Intranet-Portal at http://cs.med.siemens.de.

Replace all internal batteries at the same time, the two standard internal batteries as well as the two extra internal batteries if fitted (optional).

After battery installation or replacement, allow the batteries to recharge before clinical use of the KION / KION-i workstation.

Performing the battery replacement

- Battery replacement is described in chapter "Disassembling and assembling" section "Internal battery".
- Discard the old batteries. Worn-out batteries must be returned to the place of purchase or to a place where they can be safely disposed of. Batteries must not be disposed of with ordinary waste.



Always keep the battery cable disconnected when working inside the Power & Communications Interface.

When removing or installing batteries, be very careful with service tools, connection cables, etc, in order not to short-circuit the batteries.

Checking the internal battery after replacement

- Allow the internal battery to charge until the battery indicator on the KION Monitor shows "*100%*". This charging time must not be longer than 12 hours.
- Run the KION / KION-i workstation on the internal battery (with mains power disconnected) until the alarm "*No Battery Capacity Left*" is activated. This event is logged in the Diagnostic Log. There is no need to supervise the workstation during the test.
- Verify the condition of the battery by checking the Diagnostic Log. The time between the alarm "*Disconnect*" and the alarm "*Limited Battery Capacity Left*" must be at least 40 min or 130 min if the KION / KION-i workstation is equipped with Extra internal battery (optional).
- Also check that the time between the alarm "*Limited Battery Capacity Left*" and the alarm "*No Battery Capacity Left*" is approx. 10 min.
- Allow the internal battery to charge until the battery indicator on the KION Monitor shows "*100%*". This charging time must not be longer than 12 hours. If "*100%*" is not reached within 12 hours, the battery does not work properly and must be replaced.

Completing the battery replacement

- Perform a "Functional check" of the KION / KION-i workstation according to instructions in the "KION / KION-i – Operating Manual".

8. Index

Only personnel trained and authorized by Siemens shall be permitted to perform installation, service or maintenance of the KION / KION-i workstation.

Make sure to prepare the KION / KION-i workstation properly before disassembling and assembling. Refer to section "Hazard notices" in chapter "Important".

Any service or maintenance must be noted in a log book.

Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

After any installation, maintenance or service intervention in the KION / KION-i, perform a "Calibration" and a "Function check".
Refer to the "KION / KION-i anesthesia workstation – Operating Manual" for details.

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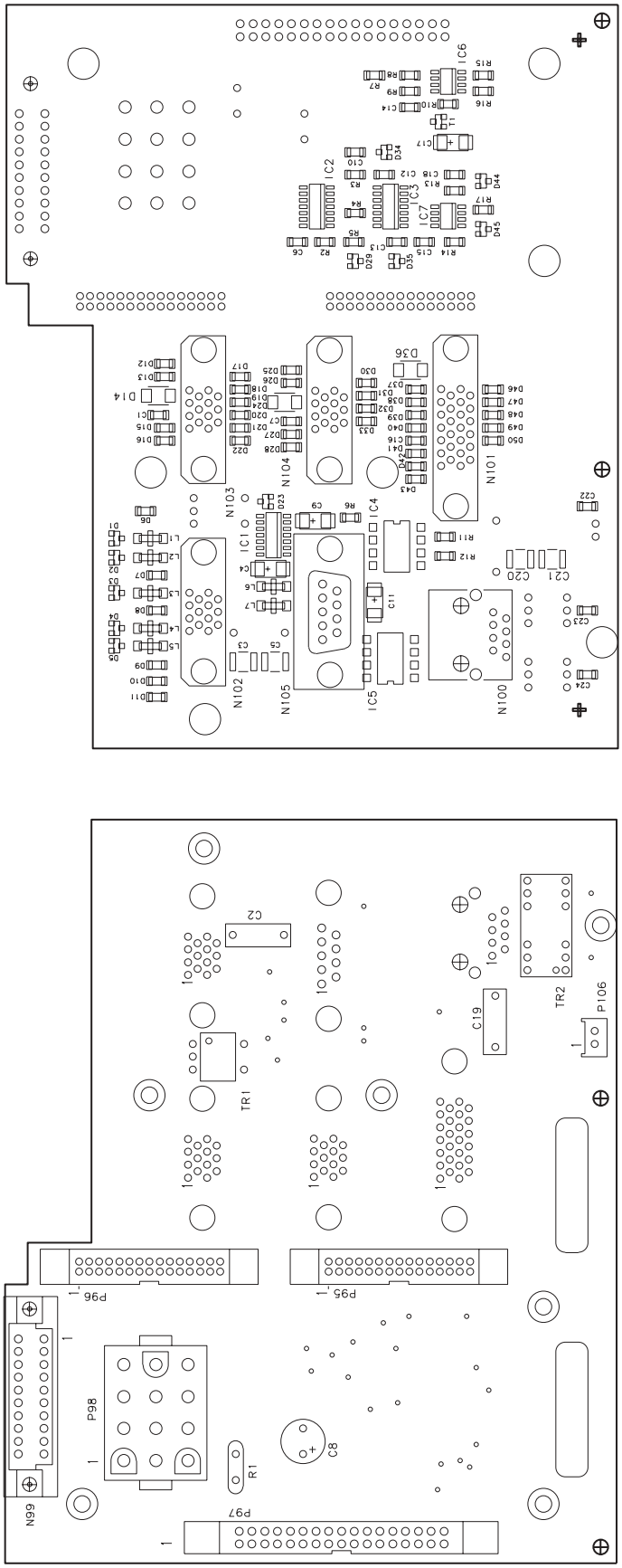
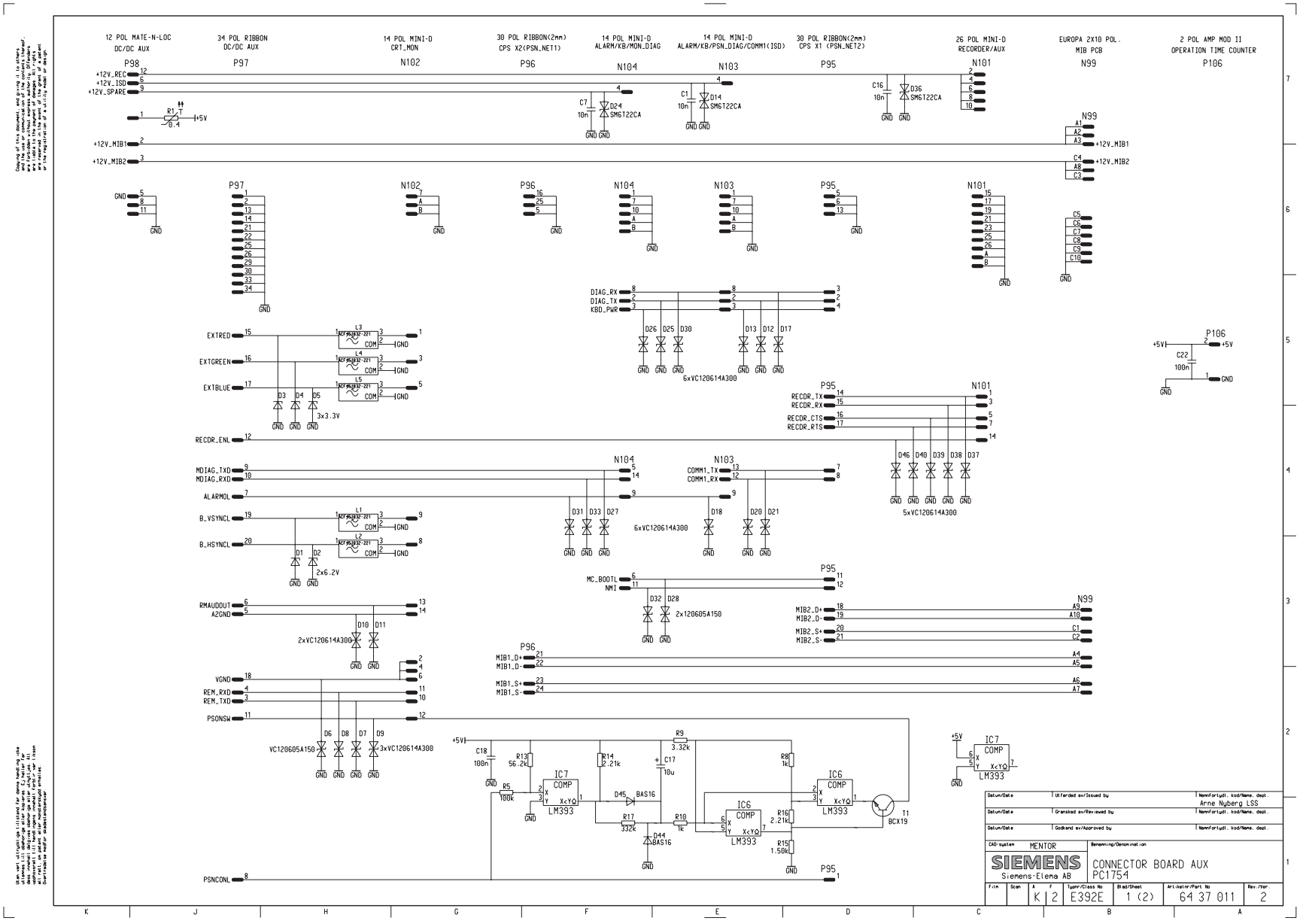
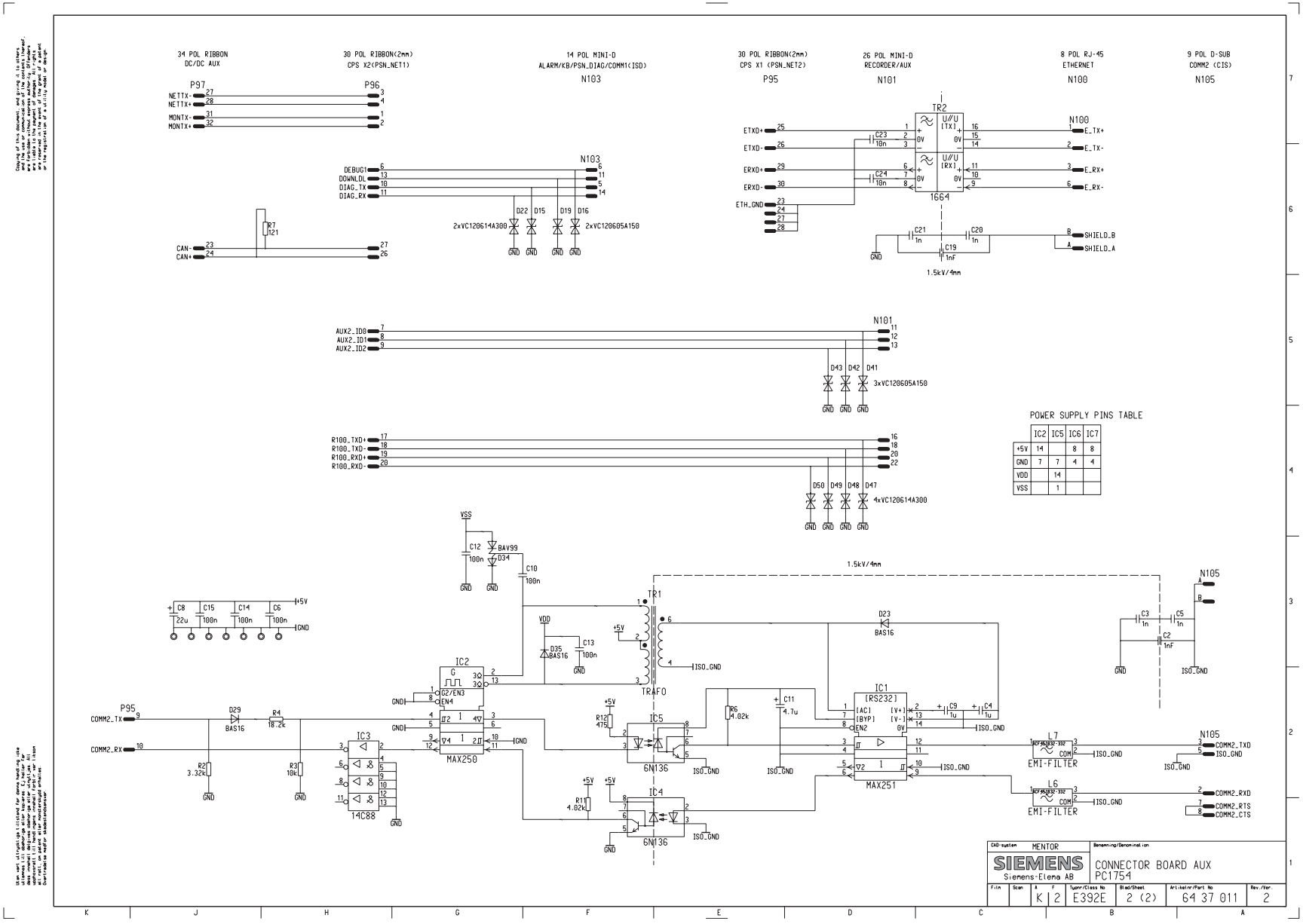


PC 1754 Connector – Layout

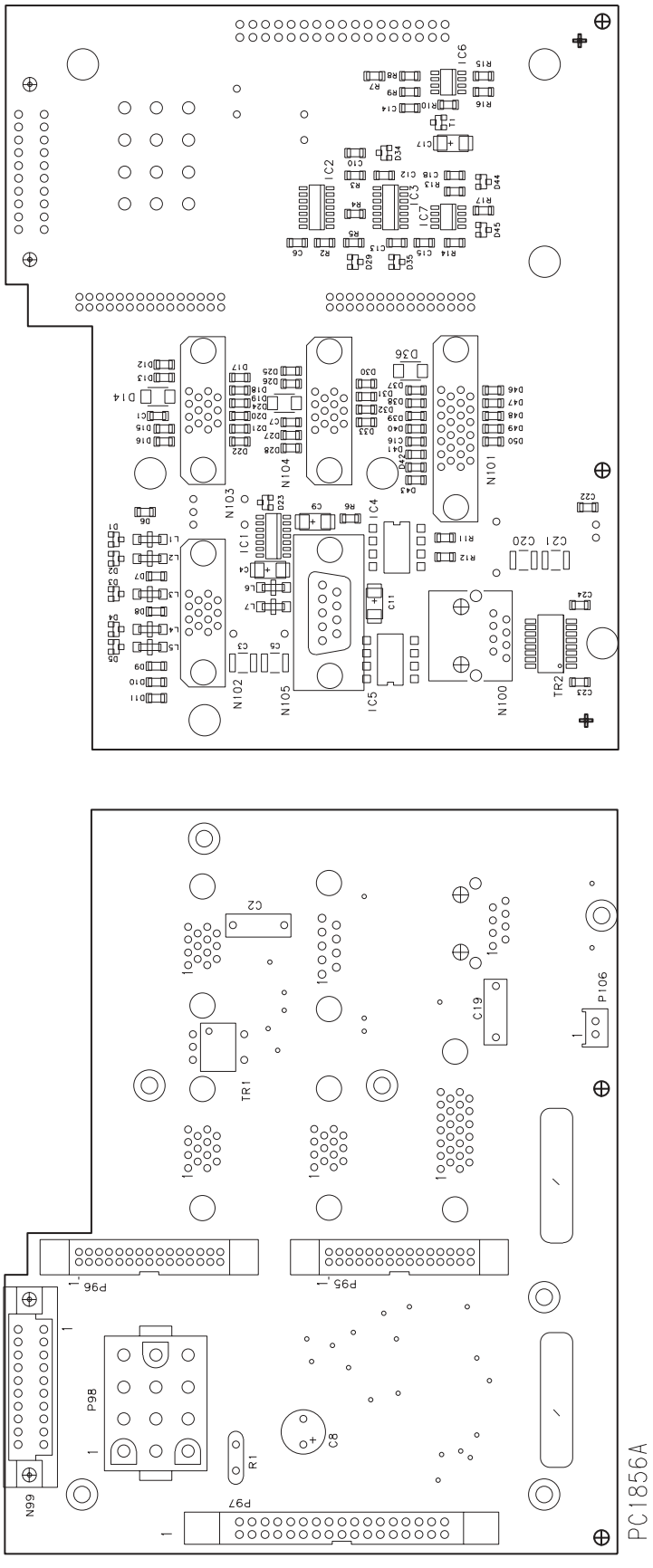
9



PC 1754 Connector – Circuit diagram, page 1 (2)

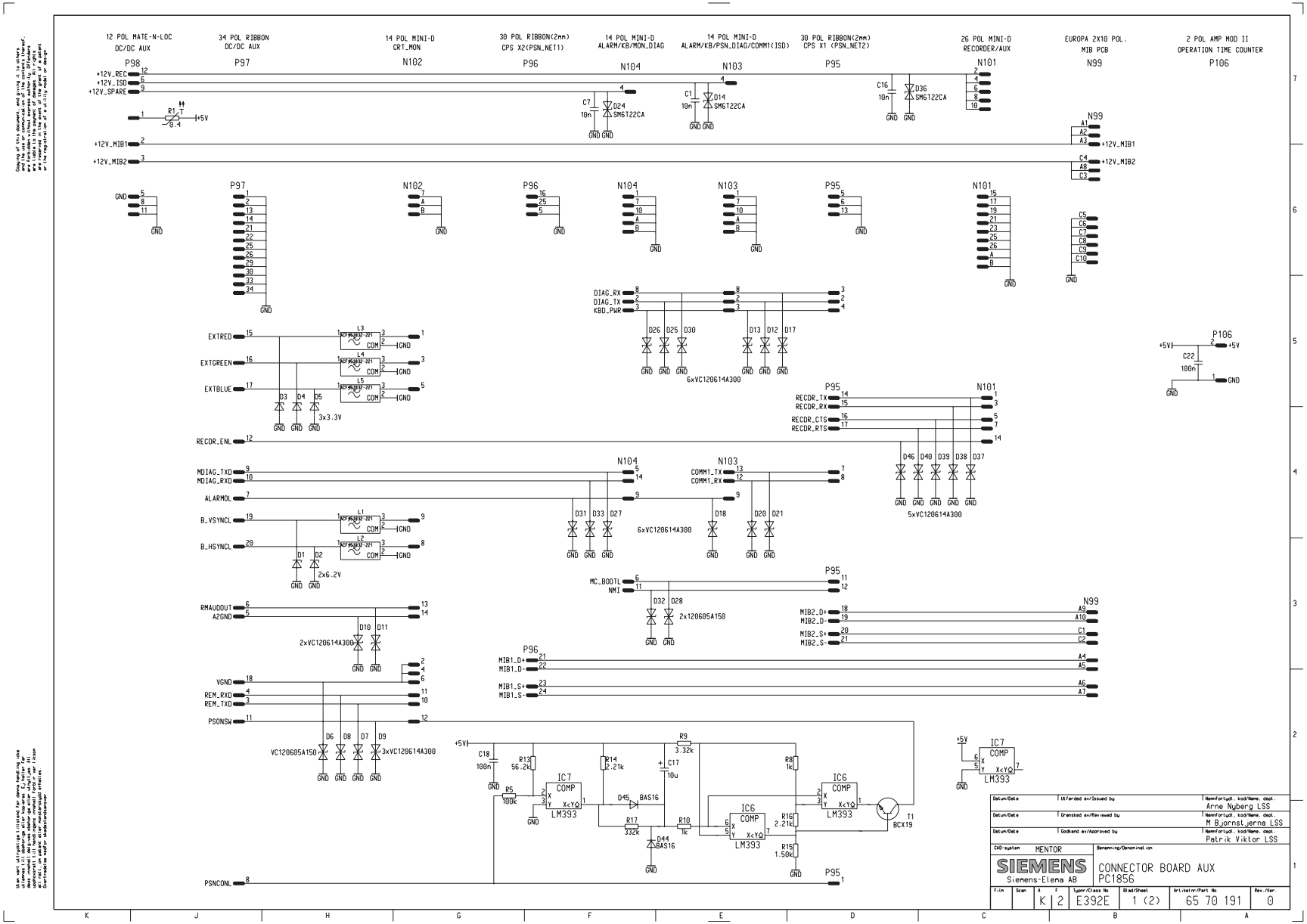


PC 1754 Connector – Circuit diagram, page 2 (2)

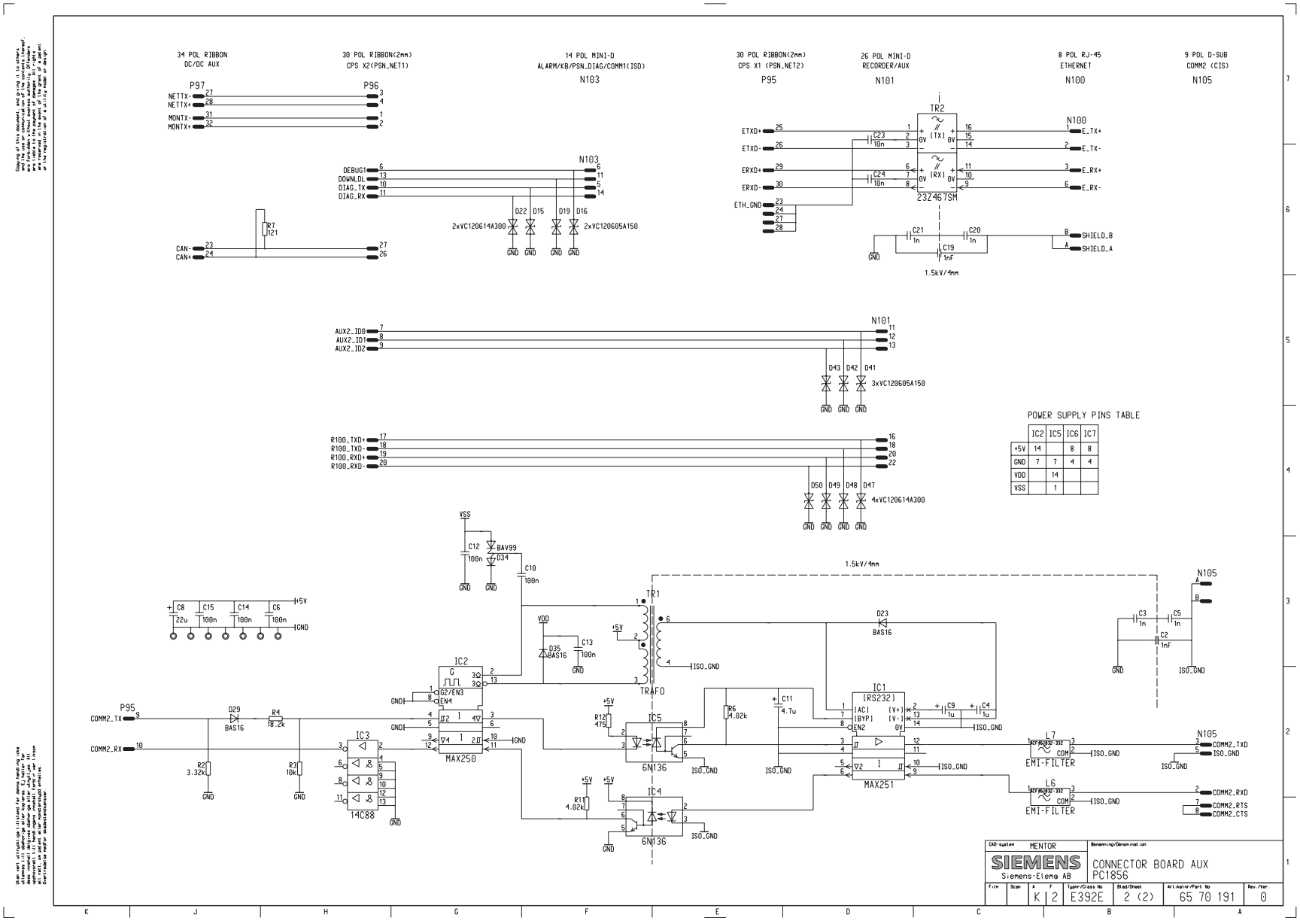


PC 1856 Connector – Layout

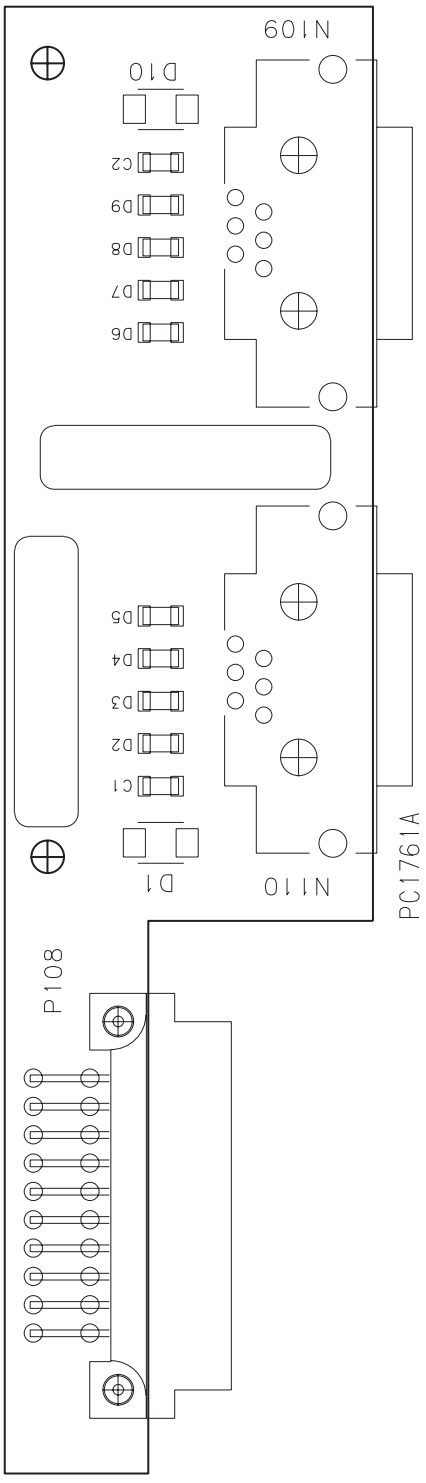
9



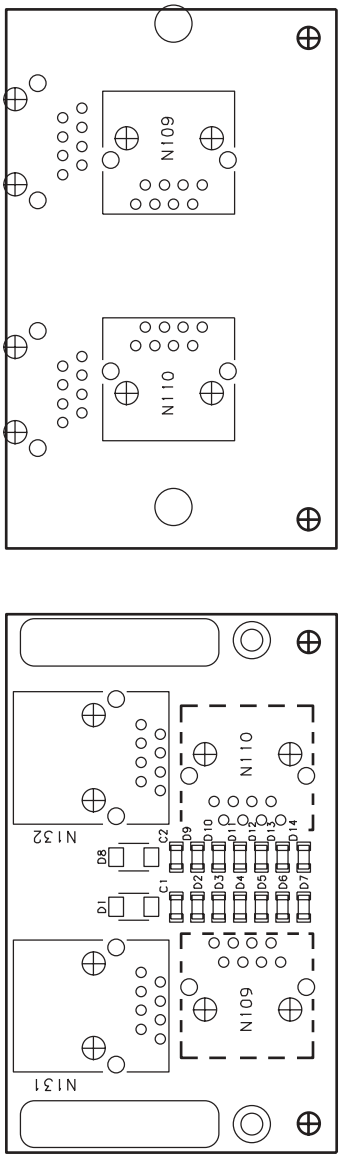
PC 1856 Connector – Circuit diagram, page 1 (2)



PC 1856 Connector – Circuit diagram, page 2 (2)

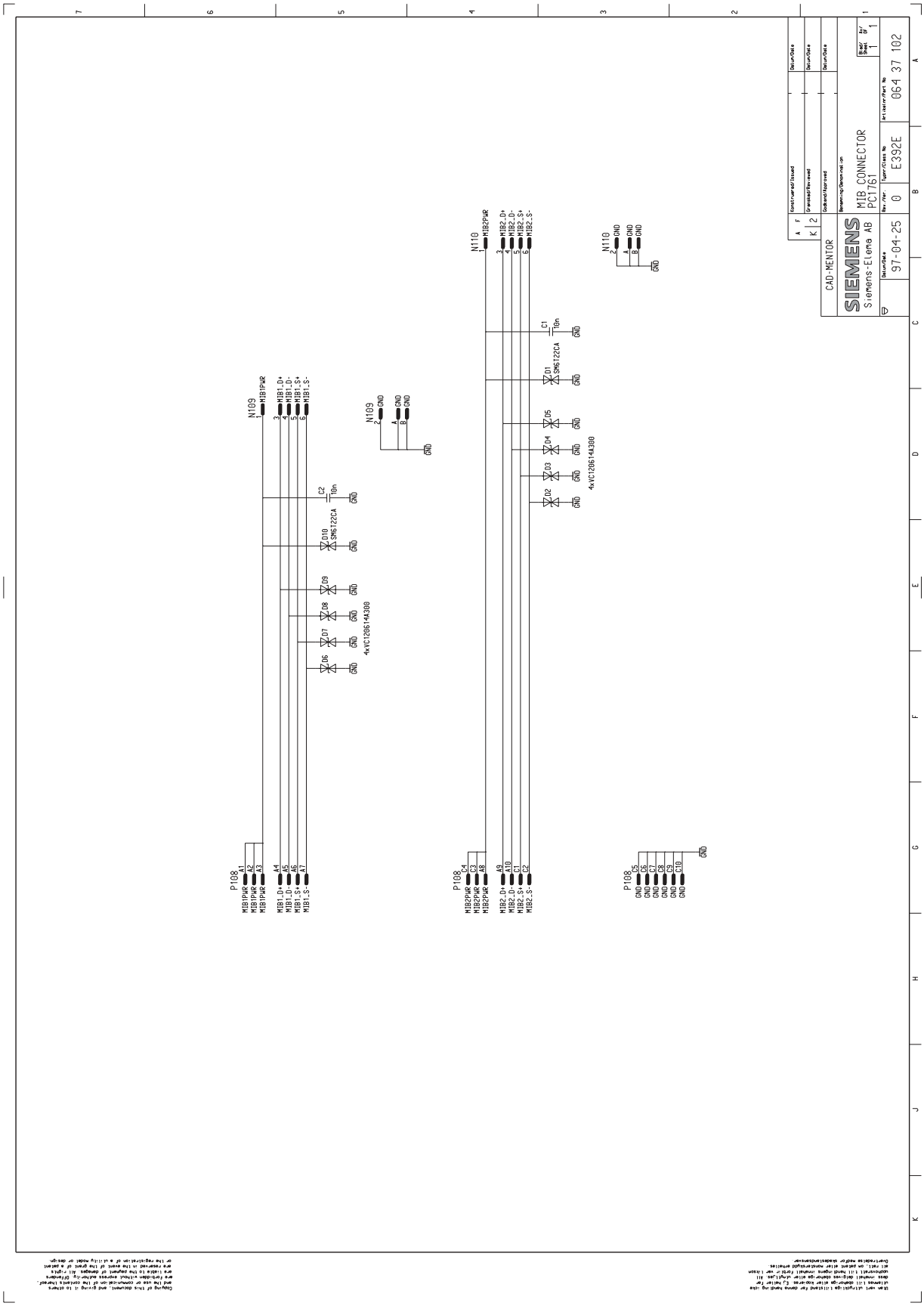


PC 1761 MIB Connector – Layout



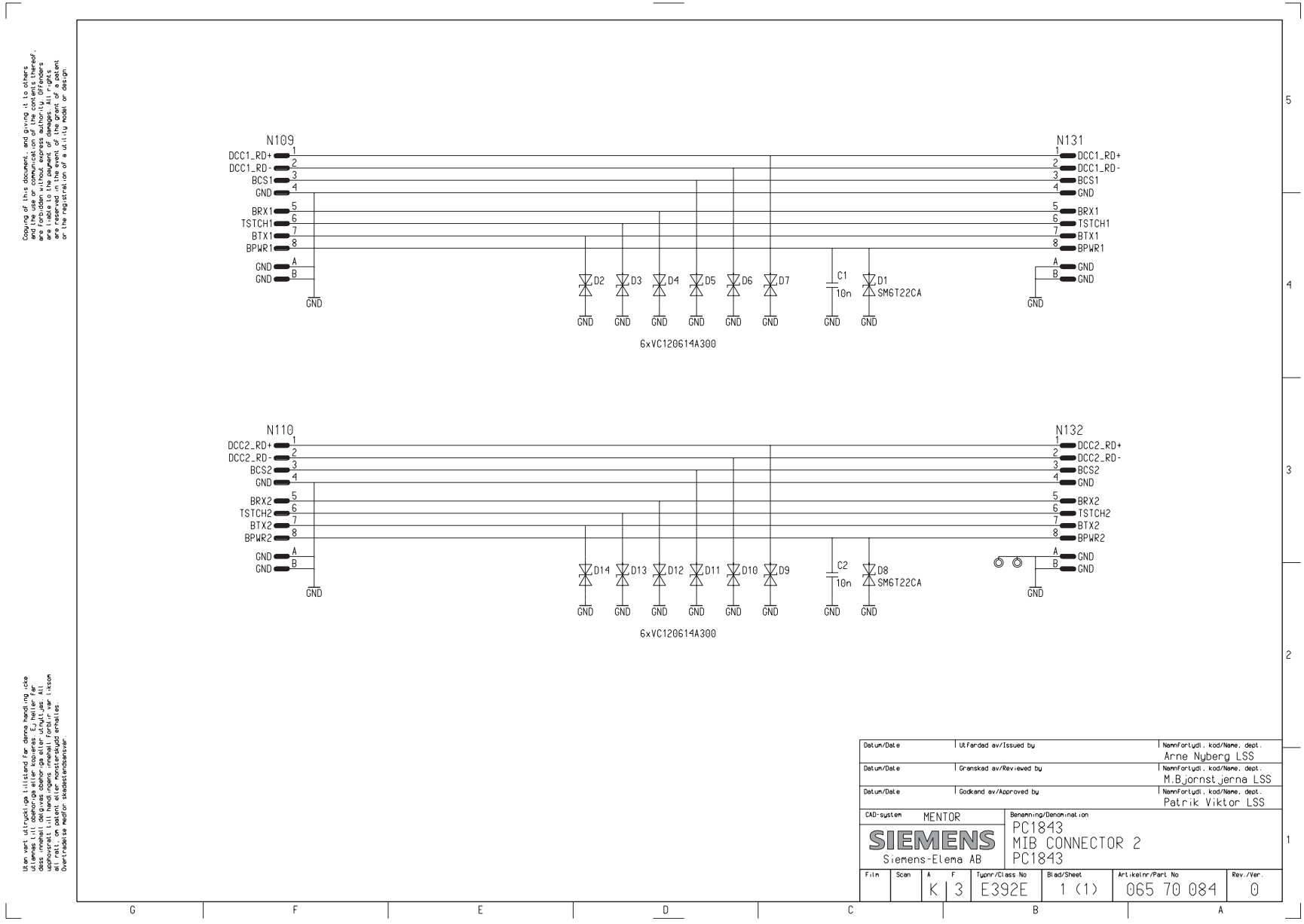
PC 1843 MIB Connector 2 – Layout

9



PC 1761 MIB Connector – Circuit diagram

9



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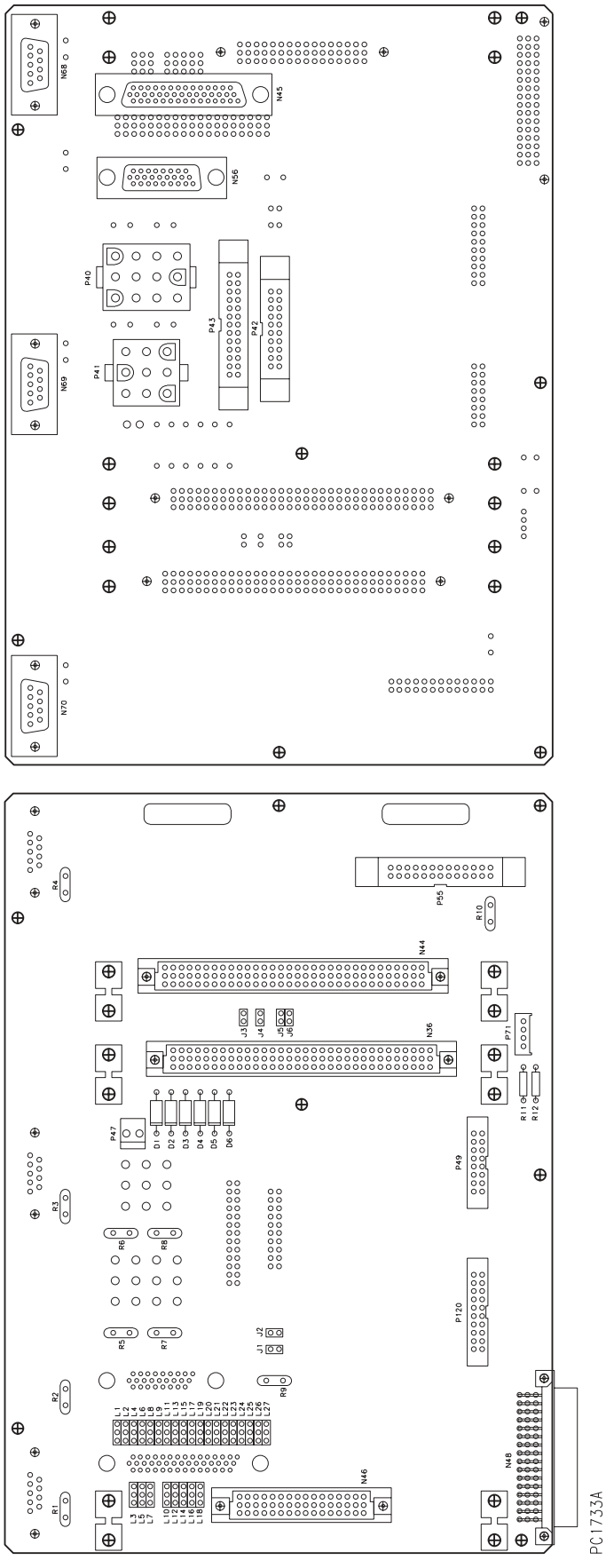
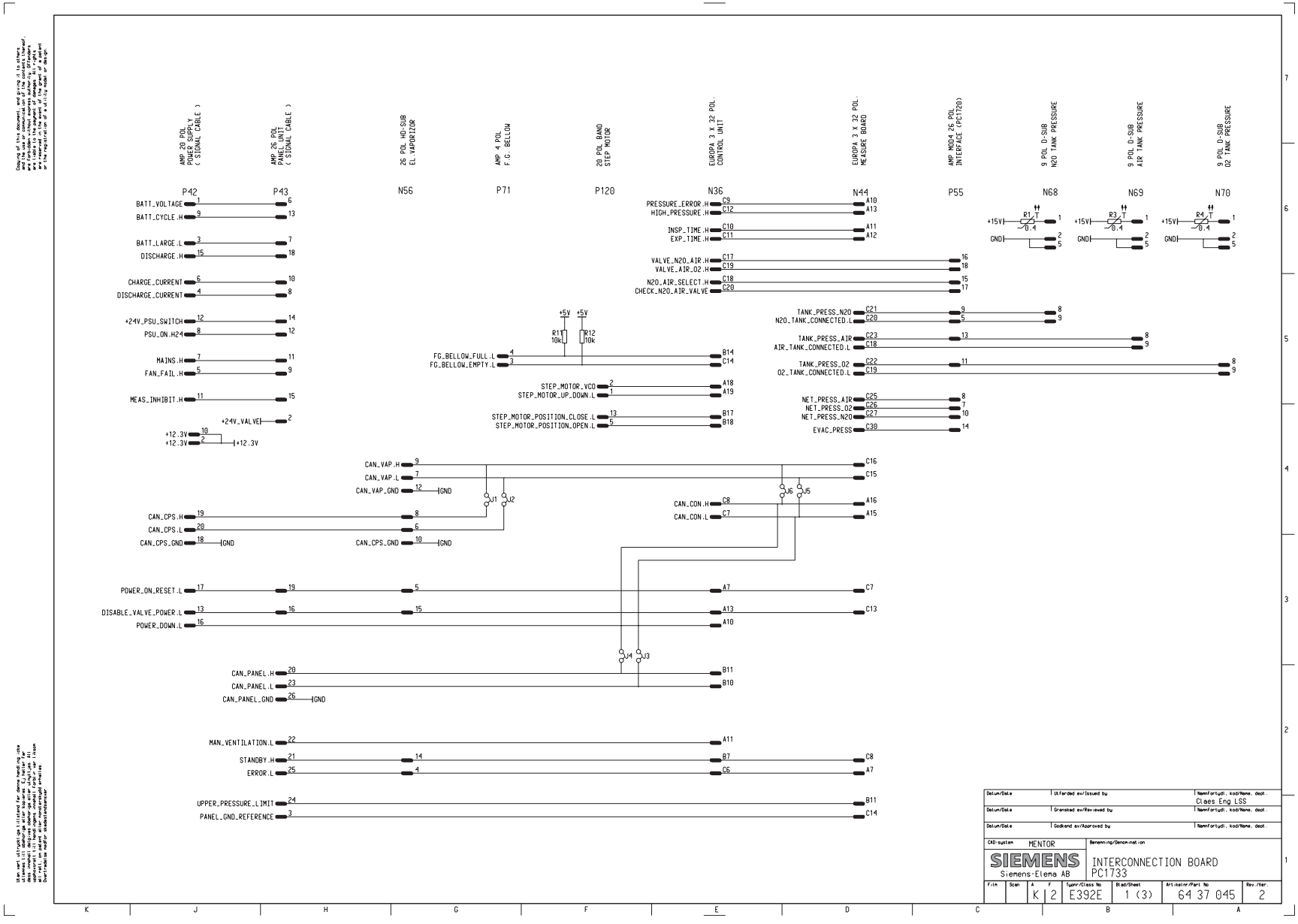
Utan vårt uttryckliga tillstånd får denna handling icke utlämnas till obehörig eller kopieras för att sådan åtgärd skall kränka lagen om upphovsrätt till handlingens innehåll förbjuder vår lisson all rätt, om patent eller mönsterskydd anmäles. Överträdelse medför skadeståndsansvar.

PC 1843 MIB Connector 2 – Circuit diagram

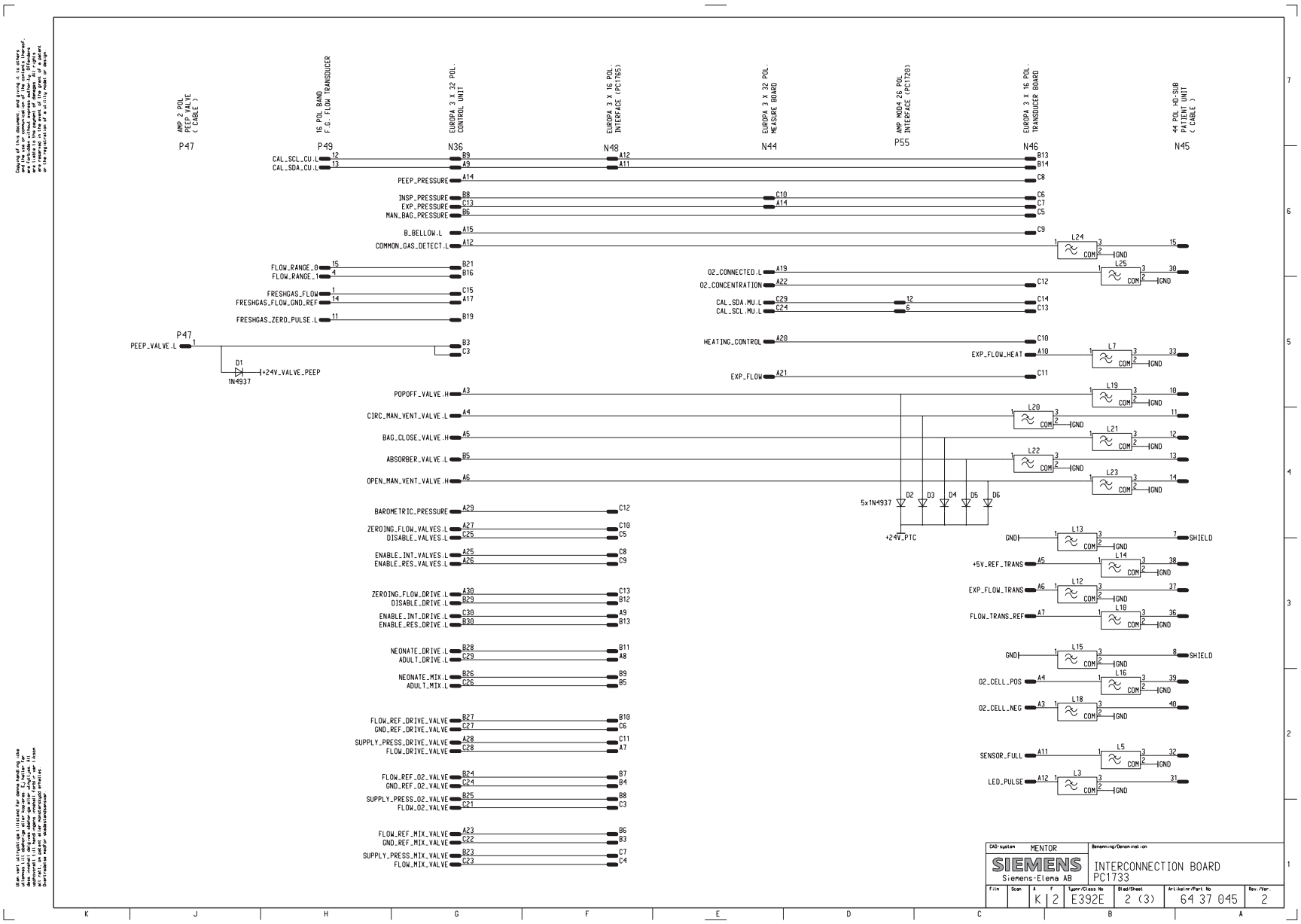


PC 1733 Interconnection – Layout

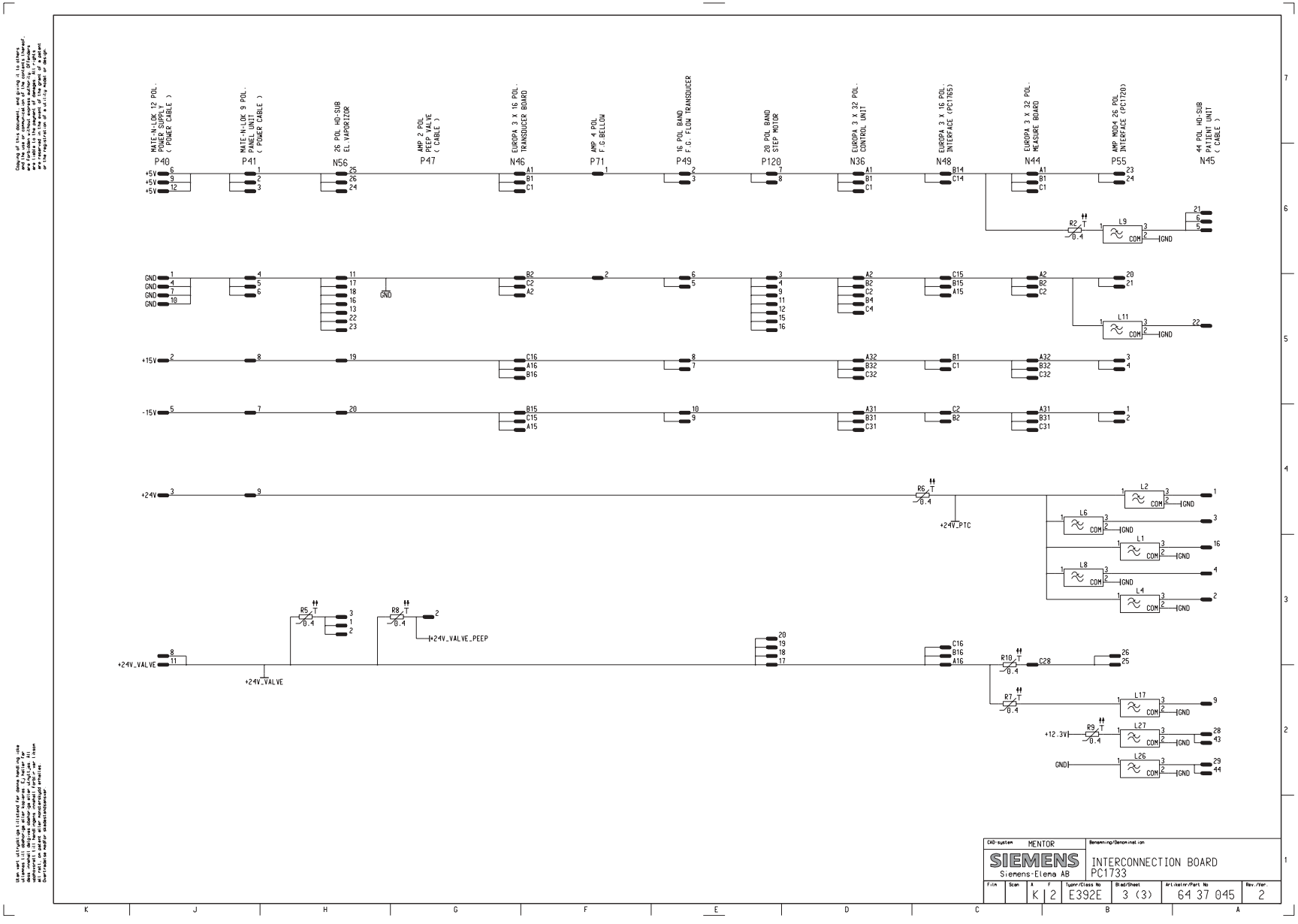
9



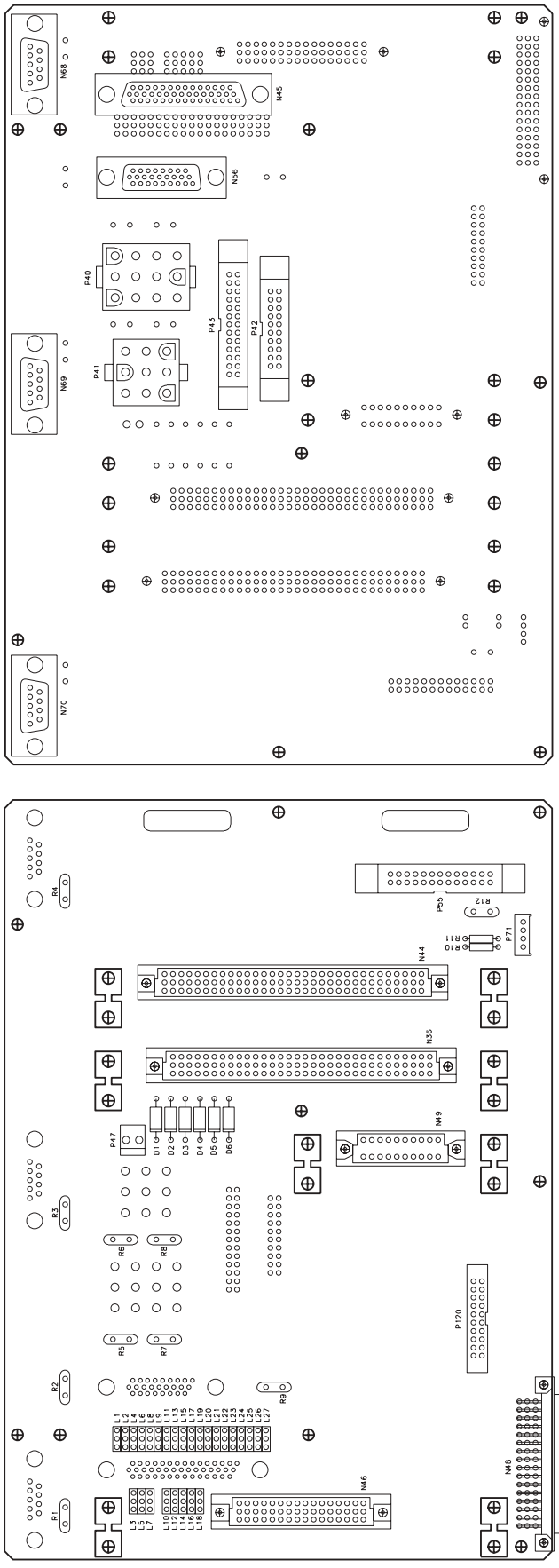
PC 1733 Interconnection – Circuit diagram, page 1 (3)



PC 1733 Interconnection – Circuit diagram, page 2 (3)

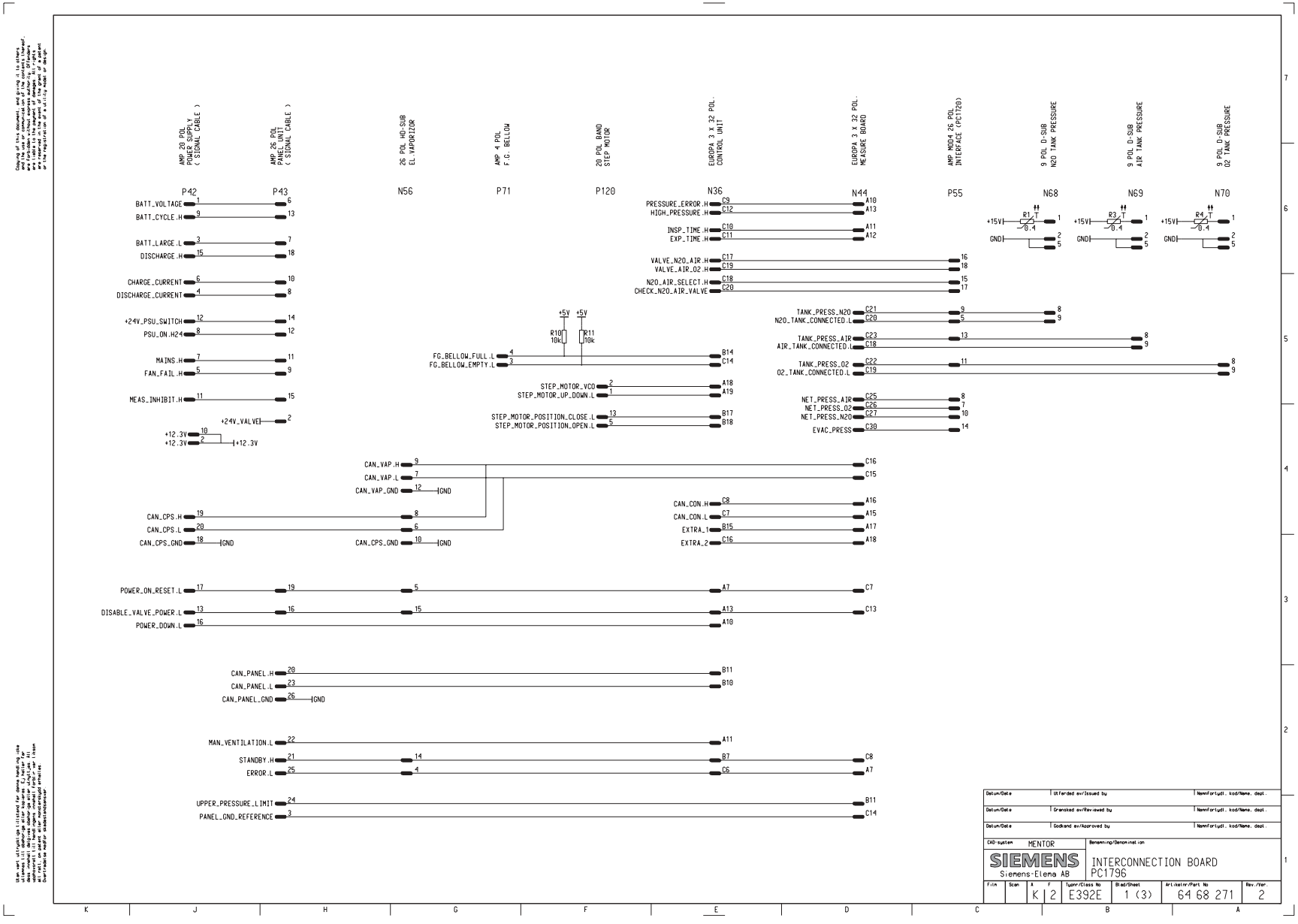


PC 1733 Interconnection – Circuit diagram, page 3 (3)

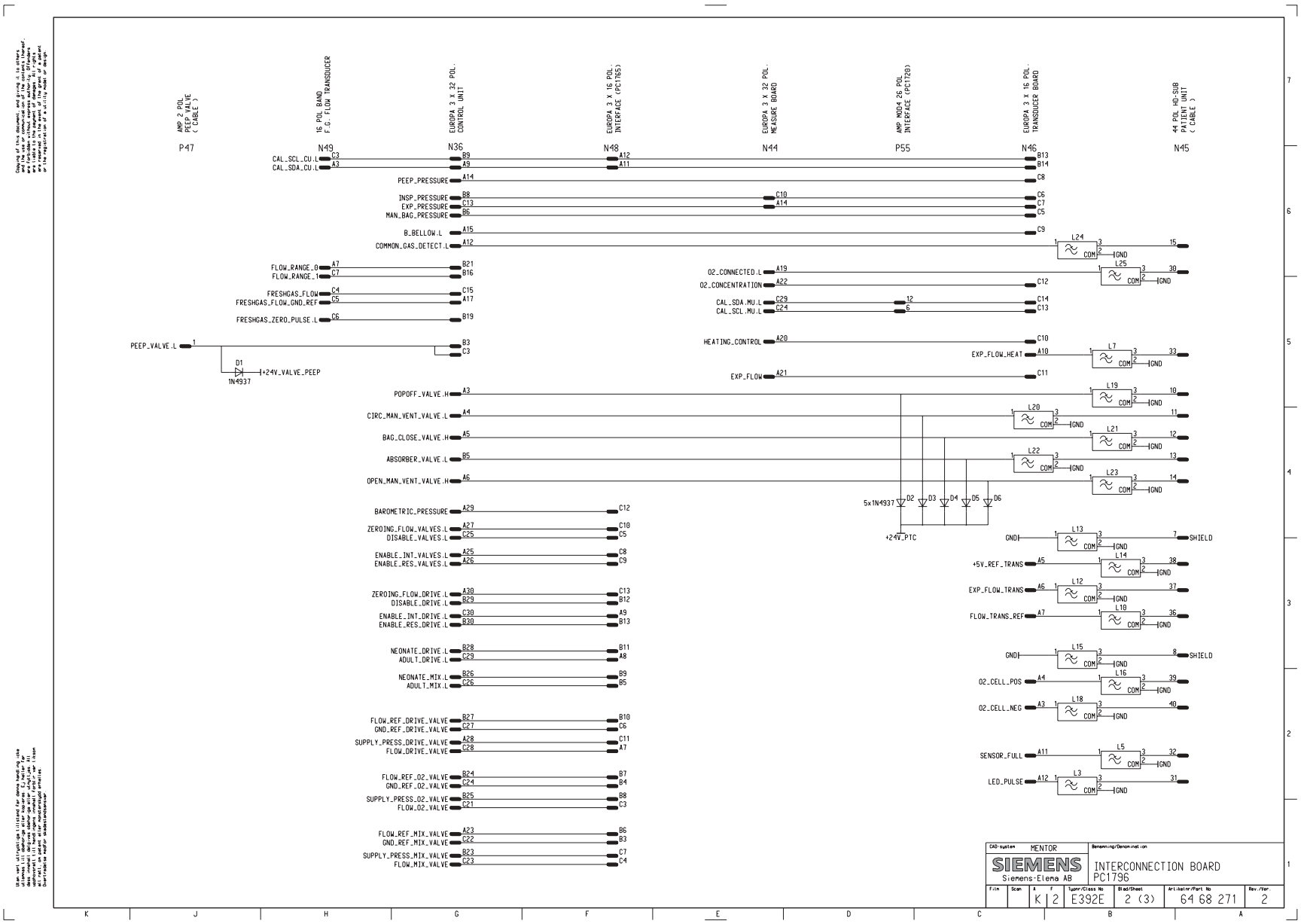


PC 1796 Interconnection – Layout

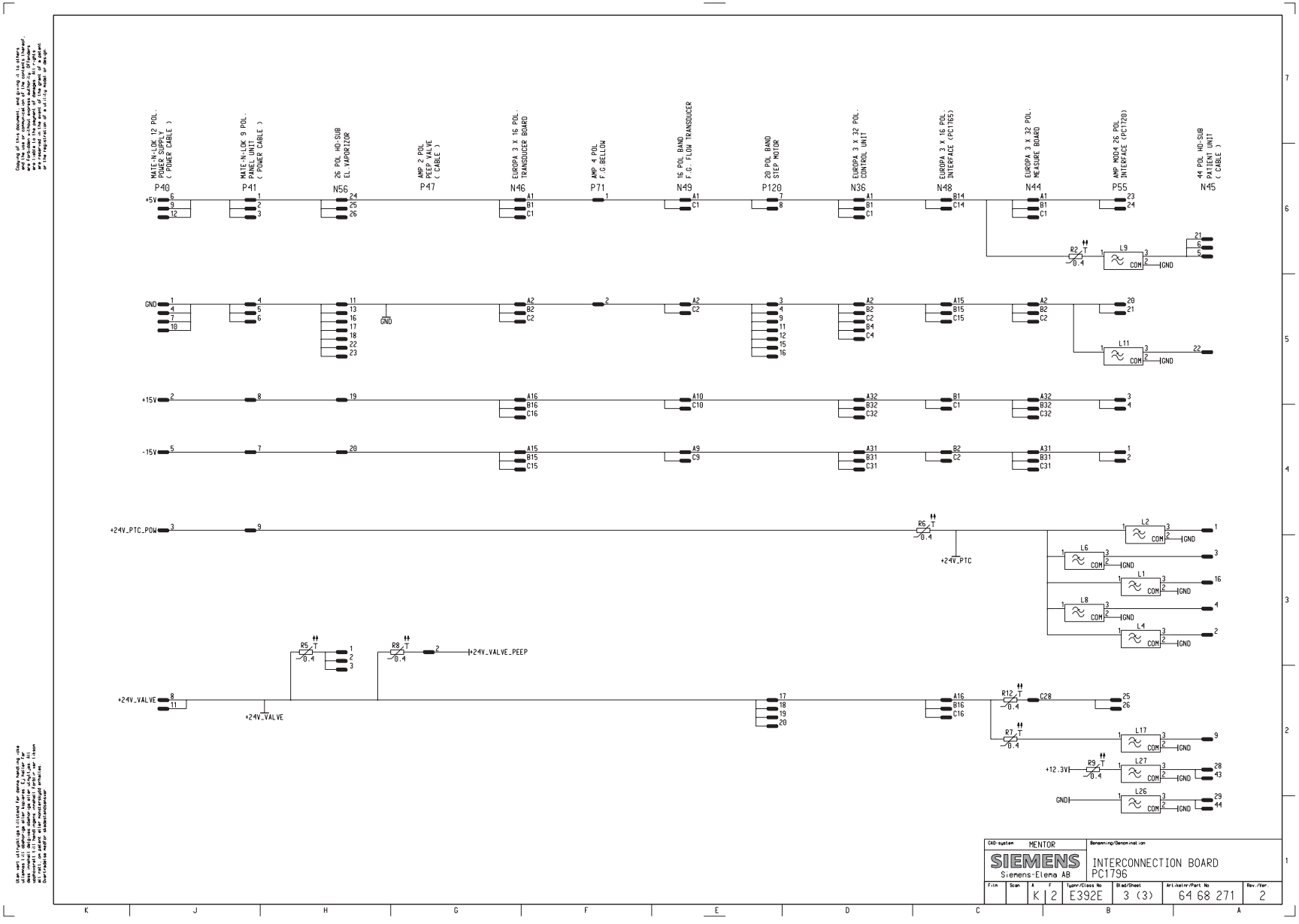
9



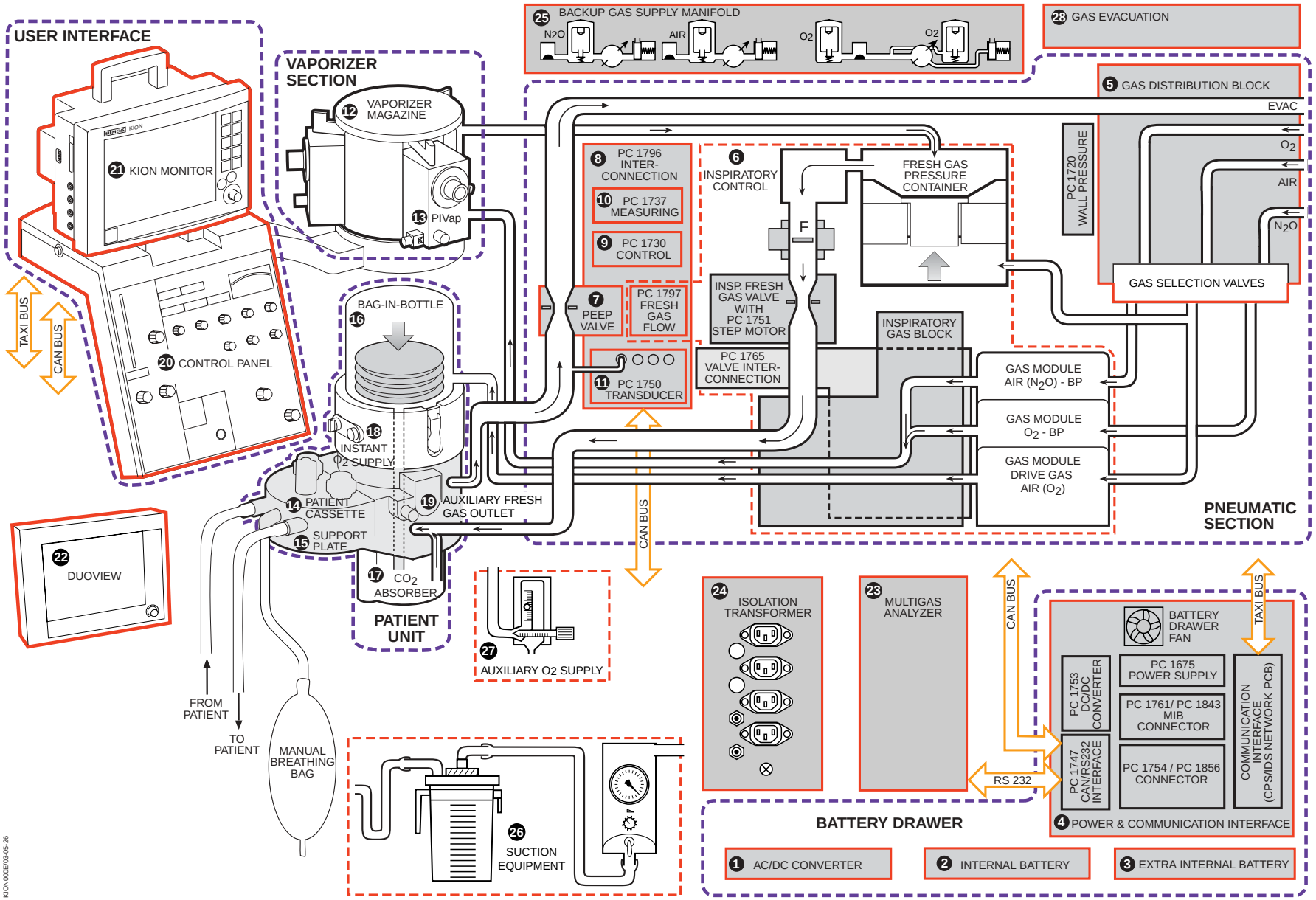
PC 1796 Interconnection – Circuit diagram, page 1 (3)



PC 1796 Interconnection – Circuit diagram, page 2 (3)



PC 1796 Interconnection – Circuit diagram, page 3 (3)


USER INTERFACE
21 KION MONITOR
20 CONTROL PANEL
TAXI BUS
CAN BUS
VAPORIZER SECTION
12 VAPORIZER MAGAZINE
13 PIVap
BAG-IN-BOTTLE
16
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15 SUPPORT PLATE
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22 DUOVIEW
FROM PATIENT
TO PATIENT
MANUAL BREATHING BAG
25 BACKUP GAS SUPPLY MANIFOLD
N2O
AIR
O2
O2
28 GAS EVACUATION
5 GAS DISTRIBUTION BLOCK
EVAC
O2
AIR
N2O
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GAS SELECTION VALVES
8 PC 1796 INTER-CONNECTION
10 PC 1737 MEASURING
9 PC 1730 CONTROL
6 INSPIRATORY CONTROL
FRESH GAS PRESSURE CONTAINER
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7 PEEP VALVE
PC 1797 FRESH GAS FLOW
INSP. FRESH GAS VALVE WITH PC 1751 STEP MOTOR
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11 PC 1750 TRANSDUCER
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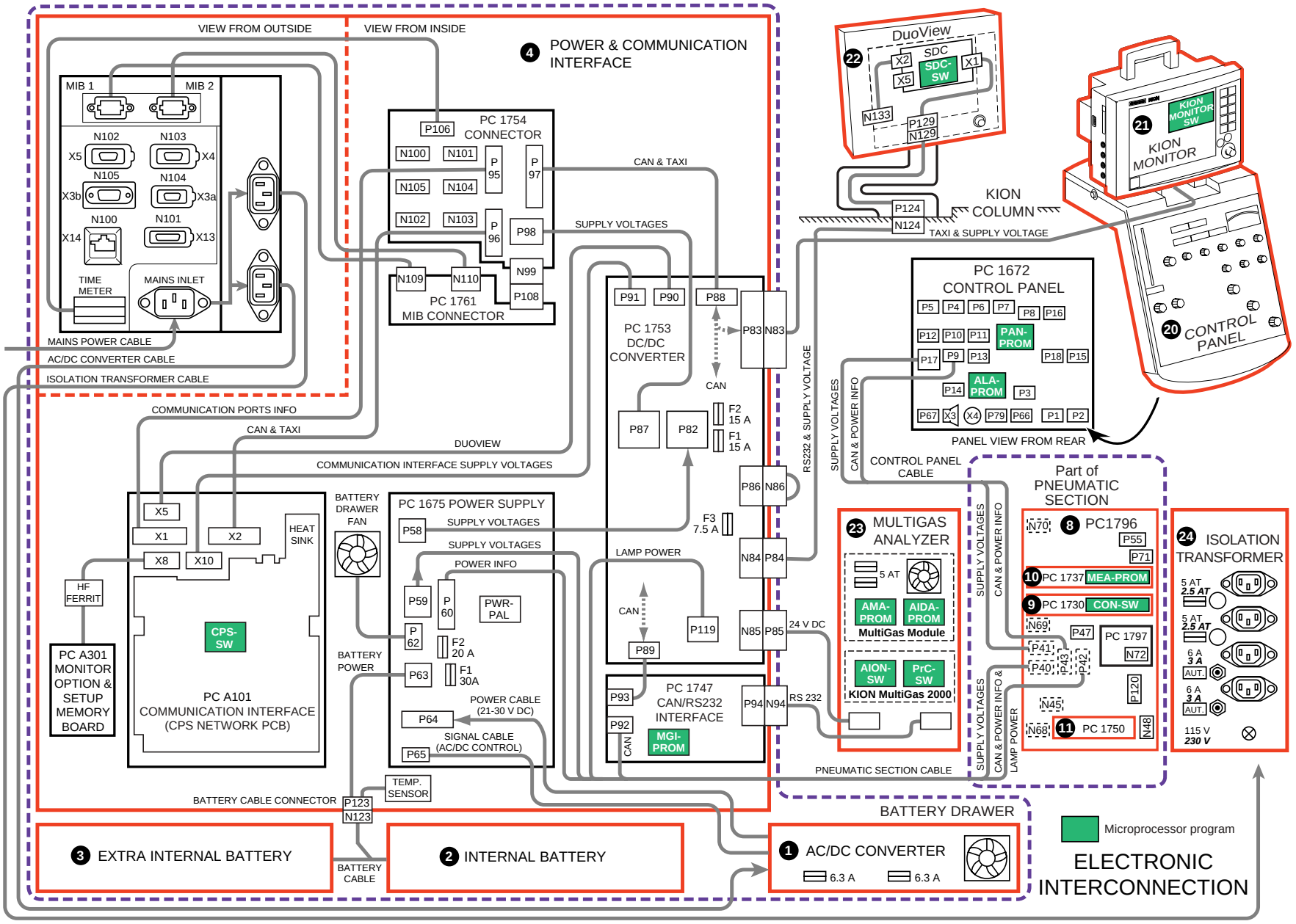
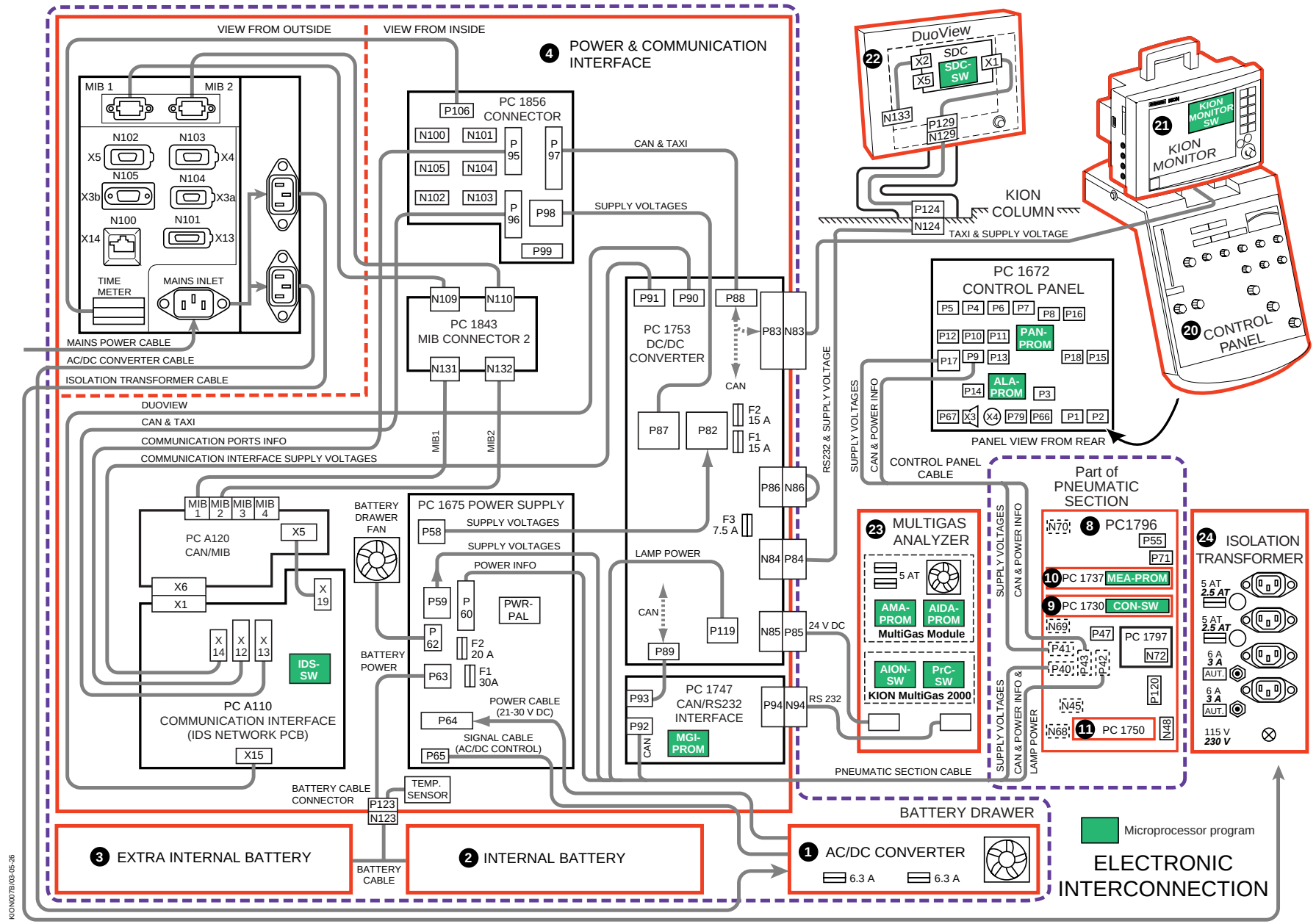
27 AUXILIARY O2 SUPPLY
24 ISOLATION TRANSFORMER
23 MULTIGAS ANALYZER
CAN BUS
TAXI BUS
BATTERY DRAWER FAN
PC 1753 DC/DC CONVERTER
PC 1675 POWER SUPPLY
PC 1761/ PC 1843 MIB CONNECTOR
PC 1747 CAN/RS232 INTERFACE
PC 1754 / PC 1856 CONNECTOR
COMMUNICATION INTERFACE (CPS/IDS NETWORK PCB)
RS 232
4 POWER & COMMUNICATION INTERFACE
26 SUCTION EQUIPMENT
BATTERY DRAWER
1 AC/DC CONVERTER
2 INTERNAL BATTERY
3 EXTRA INTERNAL BATTERY
KION000E/03-05-26



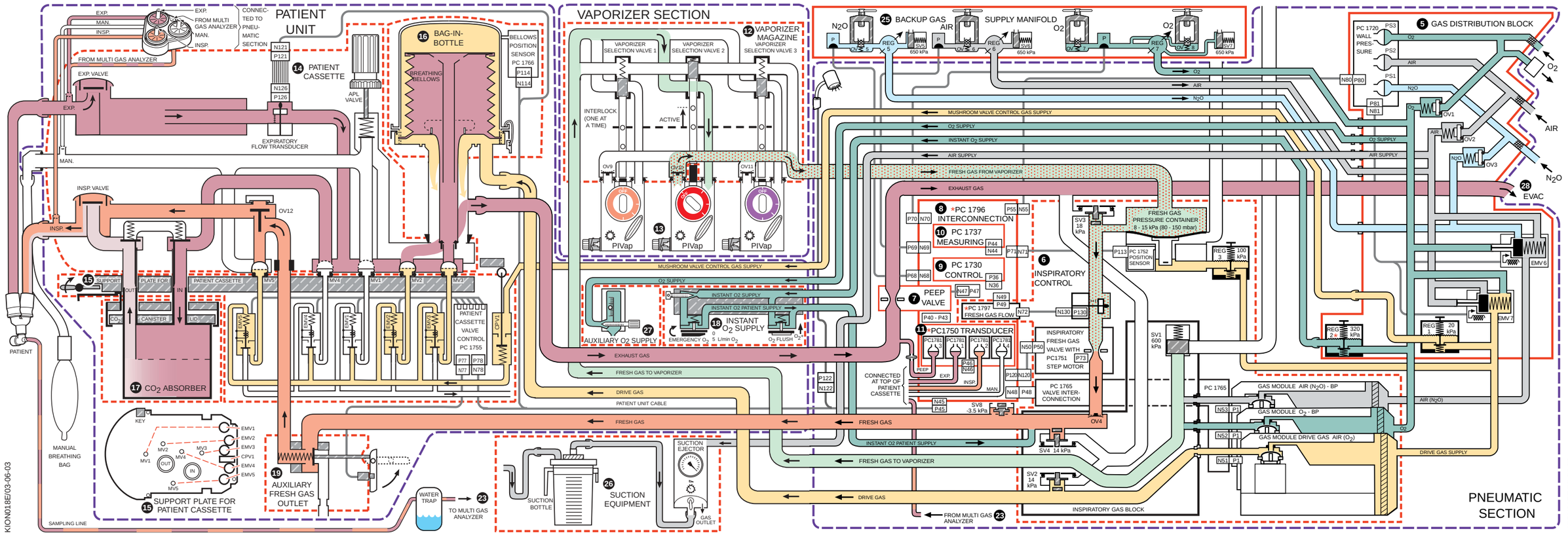
Electronic interconnection - With CPS Network PCB - For KION with S/N 03645 or lower



Electronic interconnection - With IDS Network PCB - For KION / KION-i with S/N 03646 or higher

Notes

KION / KION-i – Pneumatic block diagram



Color codes used in the block diagram

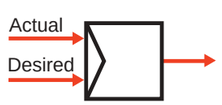
Color	Gas	Explanation
Dark green	O_2 (Oxygen)	O_2 supply.
Grey	Air	Air supply.
Blue	N_2O (Nitrous oxide)	N_2O supply.
Yellow	Air/O_2	Drive gas. Normally Air, but O_2 if the Air supply fails.
Light green	O_2 and Air/N_2O	Fresh gas to vaporizer.
Light green with dots	O_2, Air/N_2O and anestetic agent	Fresh gas from vaporizer. Pressurized by the Fresh Gas Pressure Container.
Orange	O_2, Air/N_2O and anestetic agent	Fresh gas. Regulated by the Inspiratory Fresh Gas Valve.
Dark lilac	O_2, Air/N_2O, CO_2, H_2O and anestetic agent	Expired gas from the patient. Can be used for rebreathing.
Light lilac	O_2, Air/N_2O, H_2O and anestetic agent	Rebreathing gas purified by the CO_2 Absorber.

5 — **28** Refers to section number in chapter Description of functions.

* Details of this block can be different on older KION Systems. Refer to chapter Description of functions.

The mushroom valves MV1 - MV5 control the gas flow (vertical direction in the diagram) in the patient cassette. Gas flow around the mushroom valves is always unrestricted.

Controller symbol used in these diagrams.



Notes

KION / KION-i anesthesia workstation – Service Manual
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